POWER

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E. C. HUTCHINSON, *Editor*

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Bon Cas en Avant

FROM the crow's nest on the foremast of a French liner comes periodically the cry "Bon cas en avant." All's well ahead.

The recent plunge of stock values made considerable of an upheaval in the financial pool, and people are still wondering what kind of a disturbance it may produce in the fairways of the nation's activities.

Some people lost a lot of money in a few days, but other people got it. Will they be as free spenders or as good investors?

Some people are worth a lot less today than they thought they were at the peak. Will their deflated rating result in less munificent spending?

There has been no destruction of actual values. There is as much real wealth in the country as before. There has been no impairment of our resources.

We can produce, fabricate and distribute more of the necessities, comforts and conveniences of life with less waste and less exertion than it has ever been possible for any people on earth to do before.

There is man-power enough to do this in a constantly diminishing working day, and there is a constantly increasing amount of capital available to furnish the necessary organization and machinery.

There would seem, certainly, to be no physical reason for anything other than a "bon cas en avant."

But if any considerable number of people commence to retrench, reducing the demand for products, they will throw some of those engaged in the production and distribution of such products out of work. The reduction of the purchasing power of these will still further reduce demand, and the cumulative effect may well be depression.

The danger from human mass action is that of panic. Don't sniff for smoke and don't yell Fire! Don't reduce wages, cut down your crew or start a stocking savings bank. You may be indirectly killing off your own customers or jeopardizing your own job.

F. R. Low

1930 PROGRAM

WITH this number another milestone is left behind. The year 1929 has been eventful. Power has been at the front of the procession ever leading and carrying its message to those who dwell and have their being in the power field.

Yet as the new year dawns we should fail in our trust did we not give serious thought to how we shall do bigger and better things. The eight points that "Power Stands For" are fundamental and will continue as the framework for the 1930 structure.

However, conditions and practices both economic and technical are continually changing. Thus each "point" takes on new significance and must be interpreted in the environment of the moment.

Steam power is of greater importance to the national welfare than ever before and by all the signs its prominence is secure. Well-balanced steam and hydro development has a strong position in the economic estate and hydro power alone still offers splendid opportunities. The oil engine is stepping into the field with definite prospects.

Then too there is the human side. In addition to the requirements of his profession and business, the individual will find something of that which should help him to grow in all directions and advance to bigger and better places.

Readers will find that these and the numerous other subjects within *Power's* established field will be handled with vigor and virility.

So the new year is beckoning. Welcome and more power to it!

POWER *Stands for . . .*

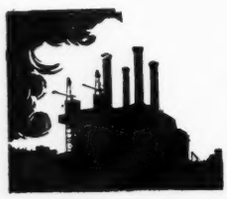
1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

POWER *was founded in November 1884 by E. P. Harris and H. M. Swetland. With it was incorporated "Steam." Ownership later passed to H. M. Swetland and James H. McGraw; then to John A. Hill and with the consolidation of the Hill Publishing Company and the McGraw Publishing Company in 1917 it became the property of the McGraw-Hill Publishing Company.*

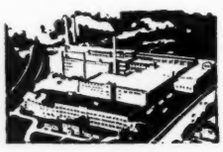
F. R. Low is editor emeritus. The editorial staff consists of Ely C. Hutchinson, editor; A. D. Blake, managing editor; G. L. Montgomery, P. W. Swain, L. H. Morrison, F. A. Annett, associate editors; Thomas Wilson, Western editor; and A. L. Cole, R. B. Purdy, H. R. Clark and L. E. Driscoll, assistant editors.

A Review of Po

THIS number of *Power* is devoted to the customary annual review of the power-production field. While the future cannot be accurately predicted, past events appear inevitably to lead toward definite accomplishments which justify optimism. In the field of steam-power generation and application, the year 1929 was very active. Exceeding the 1928 record by nearly ten billion kilowatt-hours, the total central station output for last year came close to 97 billion kilowatt-hours. Statistics are not available as to the output of industrial plants generating their own power, but the construction activity among such plants indicates that they have at least kept pace with the central stations in supplying their share of the industrial load of the country.



CENTRAL STATION generating capacity was increased by about 1,850,000 kilowatts during the year. While a considerable part of this increase is represented by new plants that went into operation, several of which contained exceptionally large units, the greater part is represented by extensions to existing stations. Construction was begun on a number of new stations during 1929, and during the latter part of the year several projected stations were announced. These will form part of the program reported through the N.E.L.A. to the recent Hoover Conference, which contemplates the expenditure of 910 million dollars by the central station industry during 1930. Among the stations now building and those projected there is a marked trend toward steam pressures of 1,200 to 1,400 pounds. The plans for these stations also indicate that increased attention is being given to keeping down the investment cost per unit of output.



A MARKED TENDENCY is evident among executives of industrial plants to pay closer and more intelligent attention to their power problems. This has resulted in a very noticelable spread of the movement, begun two or three years ago, toward modernization of industrial power plants. This has been reflected in many new plants and revamping of old plants.

Larger boilers, modern-type stokers or unit pulverizers, heat-recovery equipment, high-back-pressure or extraction turbines and relatively high steam pressures, around 400 pounds, have been widely employed. A number of plants have gone to still higher pressures, and there are now under consideration some installations that will employ steam not far from the critical pressure.

# of Power Progress in 1929

Activity among industrial plants, having use for large amounts of process steam has awakened some central station managements to the desirability of supplying both power and steam in large quantities. As a result, several plants have been built or laid down with this in view. Furthermore, in certain localities the interchange of power between larger industrials and central stations is gaining favor. These are encouraging indications that economic thinking rather than bias is being applied to power problems.

WATER-POWER development enters 1930 with brighter prospects than for some time. True, there has been a lot of gloom, but this is mostly imaginary and the result of the discovery that in many instances steam power for base load may be generated less expensively than is possible with hydro power plants of high first cost. It is apparent that this method of analysis has not taken into account social forces that continue to press for the conservation of natural resources. Water power will be developed as long as there are sites available, although the immediate expense of these developments may result in a unit cost of power exceeding that of modern steam plants. This is true conservation.

Hydro projects that involve the study and control of river flow on a large scale are receiving particular attention. For this kind of work small-scale models of dams, power houses and river stretches are more frequently used than ever before. Discoveries made by operating these models have resulted in saving vast sums of money in construction without sacrifice to safety. As their worth becomes better understood, they will be used more.

Various devices for the increase of power output from hydro stations operating on variable loads and variations in head and water quantity, are coming into service. Adjustable blades for high-speed, propeller-type turbines are gaining favor. Numerous installations of this type have been successfully made and put into service. Several methods are being projected to automatically control the output of individual hydro power units to meet the variable load demands of a system, by operating each unit at its point of best efficiency. The possibilities for increased plant efficiency by this method as compared with hand setting are great.

At this time there is approximately 1,500,000 hp. in waterwheels and turbines under way in the shops of the waterwheel builders in the United States. About 1,100,000 hp. of this will be installed in this country. The remainder, 400,000, is under construction for projects in Russia and elsewhere.

Canadian hydro-power construction is very active. Work in process there is almost as great as that in the United States. Most of it is being done by companies from designs supplied through trade connections with the largest manufacturers in the United States. Both in this country and Canada large projects have already been started which will require extensive purchase of hydro power machinery during the new year. There is strong evidence of an increasing requirement for hydro power machinery for the year 1930.

A number of individual accomplishments during the year are deserving of special comment:

The adoption by the London Conference of the kilocalorie as the international heat unit and the agreement reached on the steam tables are outstanding.

The Tokio Engineering Congress was well attended. It fully justified its position as an important event leading to the Second Plenary Meeting of the World Power Conference in Berlin next April.

In the power machinery field the superimposed, or steeple-compound, turbine has made its bow as a contemporary of the high-pressure boiler.

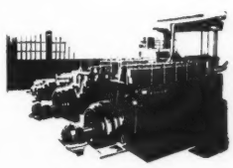
A generating unit has been built to operate at 1,000 degrees Fahrenheit, and a single boiler unit has operated at the rate of 1,250,000 pounds of steam per hour.

The field for the utilization of coal having a low temperature fusing ash has been greatly enlarged by the success of the slag-tap furnace.

For the generation of high-pressure steam, the use of water walls in low-pressure boilers is making headway.

The first all-welded condenser has been put into service, and construction of all-welded casings for steam turbines has been inaugurated in the building of several small units.

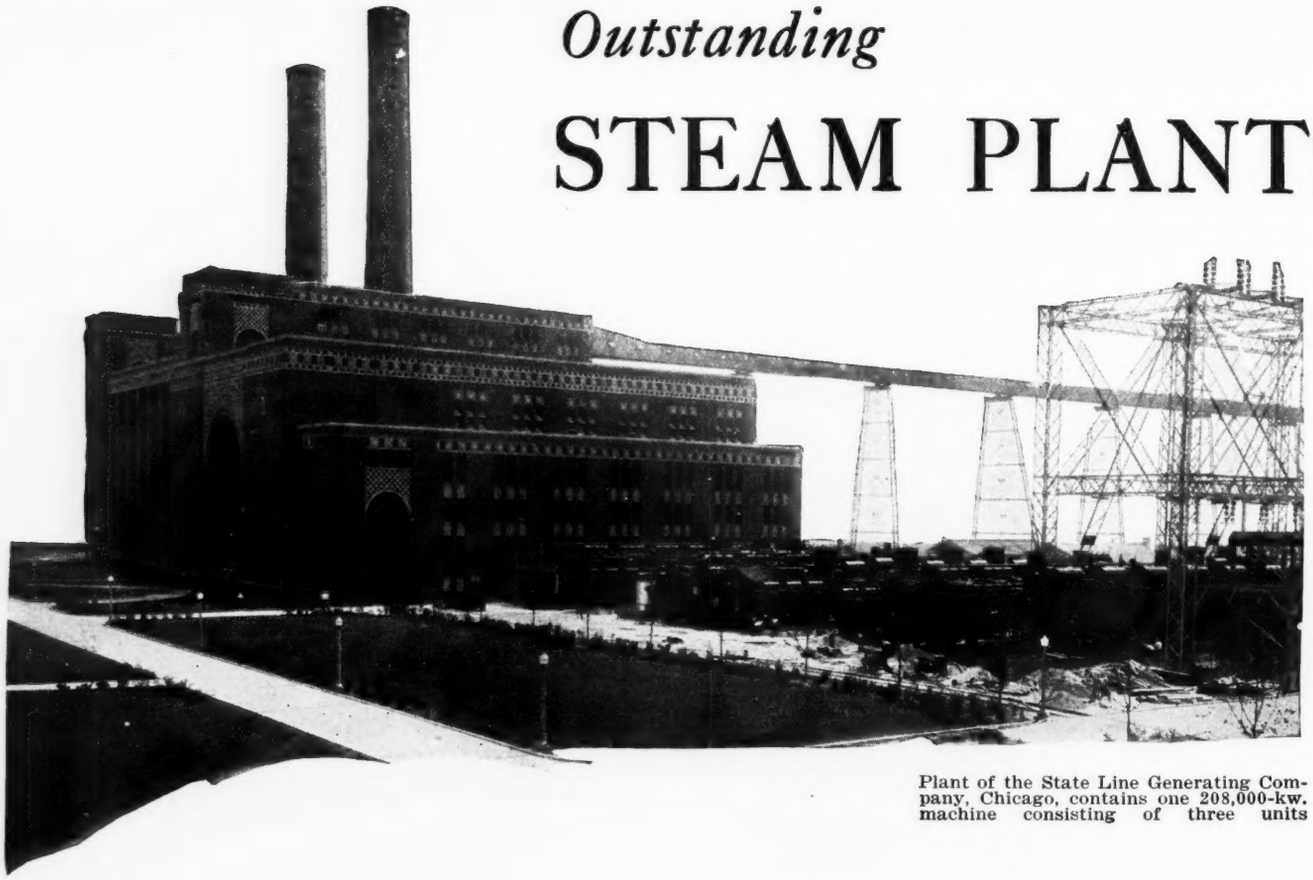
All-welded steel-plate construction for electric generators and pressure parts for hydraulic turbines had made progress during the year and may be *expected to continue.*



THE YEAR registered a revival of the large gas engine, of which over forty units of one thousand horsepower capacity were sold for pipe line compressor plants. The smaller natural-gas engine again became the favorite drive in the oil fields. Application of the Diesel engine for industrial plants has been widened, and in spite of the marine situation, the total horsepower installed was practically equal to that of any former year.

Reports of steam-power manufacturers for the first ten months of 1929 indicate a volume of business greatly in excess of the banner year 1928. While the last two months may have shown a slight falling off, the business on the books and the amount of new construction projected should keep the shops busy for some months to come.

Outstanding
STEAM PLANTS C



Plant of the State Line Generating Company, Chicago, contains one 208,000-kw. machine consisting of three units

REVIEWING the various power stations that have gone into service or have been projected during the year, it is evident that the trends of 1928 are continuing and will carry over into 1930. There has been refinement in equipment design. Rehabilitation programs to establish the heat balance or increase capacity at a comparatively low cost per kilowatt are prevalent. Exact water conditioning and the use of water walls and improved air-cooled furnaces are contributing to continuity of service. Better use is being made of fuels through improved combustion equipment. Waste heat and waste fuels are being utilized to better advantage, and in certain localities cheap natural gas as boiler fuel has become an economic factor.

Definite attempts to lower the initial investment in generating stations are being paralleled by efforts toward a reduction in operating costs. To this end stations and individual units are larger. Boiler surfaces are being rearranged, operation is being carried to higher ratings, and to meet the urge for lower building costs double-deck generating units are a new departure of the year.

Extensive and unprejudiced studies, balancing initial cost against fuel saving, are forcing the conclusion that the 1,200 to 1,400-lb. station has a definite commercial advantage under certain conditions. Notable examples appear in both the utility and industrial fields.

Among central stations, magnitude of system, plant and unit and larger output seems to be the order of the day. In the industrial field many organizations have expanded and have therefore found it necessary to analyze their power problems. This has resulted, especially in the process industries, in the modernization and extension of existing plants or the installation of entirely new generating plants, many of which are employing steam pressures of around 400 lb. In this respect, paper, textile mills and chemical plants have been most active. Advantage has been taken of higher steam pressures to employ high back-pressure or extraction turbines. In some plants where high steam pressures and high boiler outputs have made pure feed water imperative, evaporators have been used to supply the steam for process. Accumulators have been installed in a few cases to even out the steam demand on the boilers.

In certain localities private plants have been installed in office buildings, and in two cases, one a hotel and the other a department store, steam plants have been supplemented by Diesel engines to improve reliability and summer heat balance.

On the other hand, exchange of power between central stations and industrial plants is gaining in favor, and in several instances utilities have built or are building stations to supply both power and steam for process to one or a number of industrial plants in the vicinity.

Typical examples of utility plants of this character are Stations 8 and 9 of the Rochester Gas & Electric Company; the new Deepwater Station opposite Wilmington, which is suppying both steam and power to a single duPont plant; the new station built by the Southeastern Production Company, of Mobile, Ala., to supply power and process steam to a mill of the International Paper Company and eventually other industrials in the vicinity; a plant under construction at Baton Rouge, La., which will supply both steam and power to a large oil refinery and feed the surplus power to the utilities system; and the recently announced low-temperature carbonization and power plant of the Industrial Power Corporation to supply electrical power, gas and process steam to the manufacturing and stock yard district of Chicago.

At Mobile the paper mill has a capacity of 170 tons of paper per day and requires 7,500 kw. to operate.

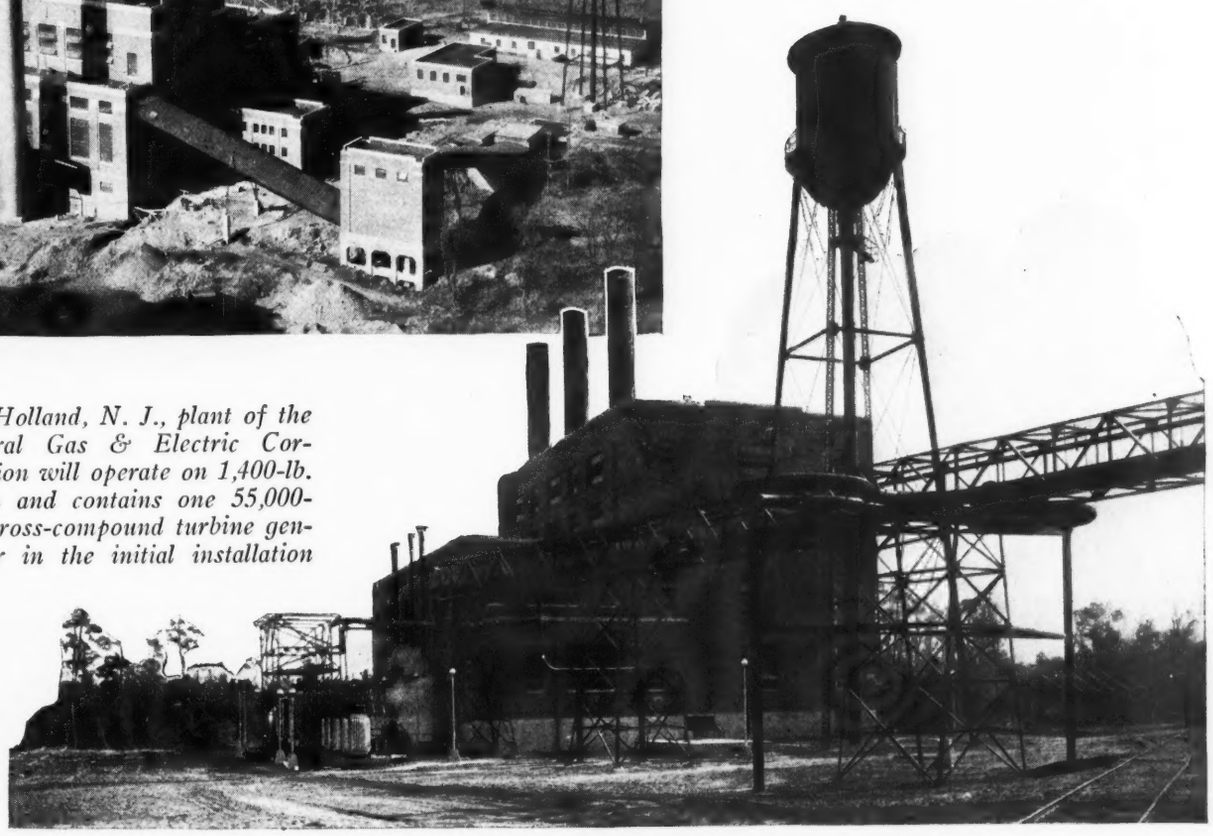
s Completed and Under Construction

Stations with units of large capacity and others designed for high-pressures are features of the year's progress in steam power developments that apply equally to central station and industrial power plants

Steam for use in process and in turbine-driven auxiliaries is at two pressures. To serve this load the initial installation is a 6,000-kw., 450-lb. turbine, arranged for extraction at 150 and 35 lb. and exhausting at 5 lb. back pressure, and a 2,000-kw. condensing unit.

Two automatic steam substations have been provided in Rochester for distributing steam to industrial plants. In one of these is a 5,000-kw. turbine-generator and in the other a 3,000-kw. machine. Control devices maintain a constant pressure of 15 lb. at the exhaust and 150 lb. at the extraction outlet. These control devices are so interlocked that wide variations in demand at either point can be handled independently without disturbing the pressure. The generators are phased in normally with the main system of the Rochester Gas & Electric Company, and the output depends entirely upon the de-

Below—Mobile, Ala., plant of the Southeastern Production Company is designed to supply both power and process steam to industrial plants. Process steam is bled from a 6,000-kw. turbine at 150 and 35 lb. gage.



The Holland, N. J., plant of the General Gas & Electric Corporation will operate on 1,400-lb. steam and contains one 55,000-kw. cross-compound turbine generator in the initial installation

mand for extracted or exhausted steam. Each installation has a group of boilers, fired with pulverized coal, that supply steam at 320 lb. and 90 deg. superheat.

Deepwater station, owned jointly by the American Gas & Electric Company and The United Gas Improvement Company contains two 53,000-kw. units that operate condensing and supply power to the companies systems. In addition to the main turbines, one 12,500-kw. unit supplies process steam and power to the plant of the E. I. duPont de Nemours & Company. All turbines are supplied by boilers operating at 1,350-lb. pressure. Exhaust from the small turbine directly passes to seven evaporators that at full load deliver 400,000 lb. of steam per hour at 180-lb. pressure. In live-steam superheaters the temperature of the vapor is raised to 440 deg. before delivery is made to the consumer. The plant thus bears the two-fold distinction of being one of the first large central stations to operate exclusively on 1,200-lb. steam and one of the first to supply large quantities of high-pressure exhaust steam to an industrial plant.

Other stations, in addition to Deepwater, that have been designed exclusively for operation at high pressure are the Holland, N. J., plant of the General Gas and Electric Corporation and the Jersey Central Power & Light Company's plant on the Raritan River at South Amboy. In each case 1,400-lb. boiler pressure was chosen for strictly commercial reasons after exhaustive studies had shown lower-pressure plants to be less desirable investments under the existing conditions. Relative to the initial cost of the Holland plant, it is significant that the boiler surface per kilowatt capacity is only 0.34 sq.ft., as compared with 1.37 sq.ft. for a 400-lb. plant.

At South Amboy the new station embodies such innovations as steeple-compound turbine-generators, gas and steam reheaters, multiple-unit pulverizers with zone combustion control, bowed-tube condensers, five-stage feed heating and high-pressure desuperheaters. Here again a boiler surface of 0.29 sq.ft. per kilowatt helps to explain the surprisingly low cost of high-pressure plants in the face of high unit cost of heating surface in forged-drum boilers.

The first 1,400-lb. units for the Pacific Coast are to be installed at San Francisco in Station A of the Pacific Gas & Electric Company. The throttle pressure for two 50,000-kw. steeple-compound turbine-generators will be 1,200 lb. at a temperature of 750 deg. F. The steam will be supplied by three boilers of 400,000 lb. per hour maximum capacity each. The boiler pressure used will be 1,400 pounds.

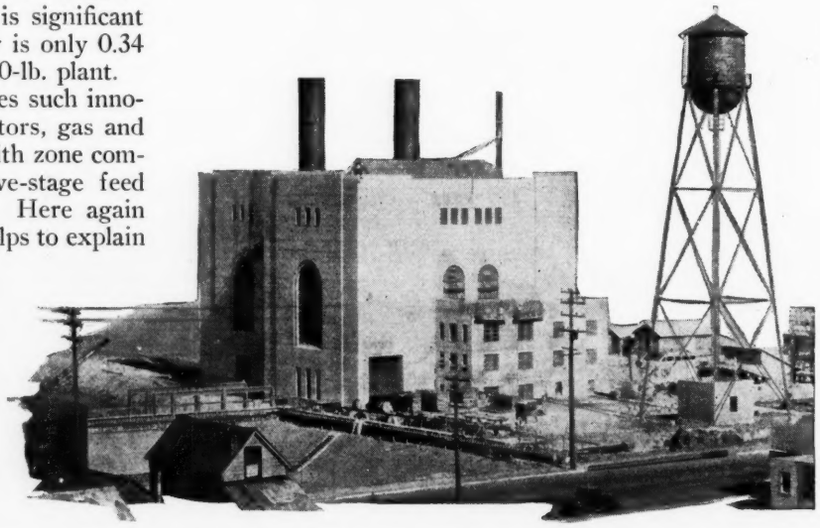
Confirming the trend to higher pressures in all sections of the country, a report comes from Texas that high-pressure equipment is on order for two plants in that state. The San Antonio Gas & Electric Company is to install a 1,400-lb. plant that will operate at 810 deg. F. The boilers will have individual ratings of 196,000 lb. of steam. Reheating between the high- and low-pressure sections of the turbines will be live steam. The Houston Light & Power Company is installing a 12,000-kw. turbine designed for 1,300-lb. pressure, which will exhaust at 380 lb. to four other turbines.

Accepting these advanced ideas on steam generation, the Ford Motor Company has announced the early installation of the world's largest high-pressure unit at its Rouge plant. This will consist of a 110,000-kw. steeple-compound turbine-generator, which is double the size of any previous 1,200-lb. machine, and two 700,000-lb.-per-hour boilers, the largest ever laid down for delivering steam at 1,350-lb. pressure. The Dow Chemical Company, Michigan, also has on order a 3,700-kw. unit designed for operation on steam at 1,400 lb. pressure.

Another industrial plant that is paving the way in power generation is that of the Philip Carey Company at Lockland, Ohio, which, as announced in last year's review, is to employ a boiler pressure of 1,800 lb., the highest ever used in America. The generating units will be vertical triple-expansion reciprocating engines taking steam at about 1,450 lb. and 800 deg. and exhausting at about 60 lb. to process. The engines have been delivered from Germany, and operation is expected next spring.

Among the plants designed for medium pressures that have gone into operation during the year, State Line Station is notable because its 208,000-kw. triple turbine-generator unit, operating on 600-lb. steam, is the largest.

For sizes of units the additions to Hell Gate and East River stations in New York City are also notable. At the Hell Gate Station two cross-compound units of 160,000-kw. and 165,000-kw. capacity have been installed, together with boilers each of which will produce a maximum of about 800,000 lb. of steam per hour at 725 deg. and 275 lb. pressure. In the East River station a 160,000-kw. tandem-compound unit has been placed in operation, together with three pulverized fuel fired boilers of the double Ladd type. One of these boilers has recently produced steam at the rate of 1,250,000 lb. per hour.



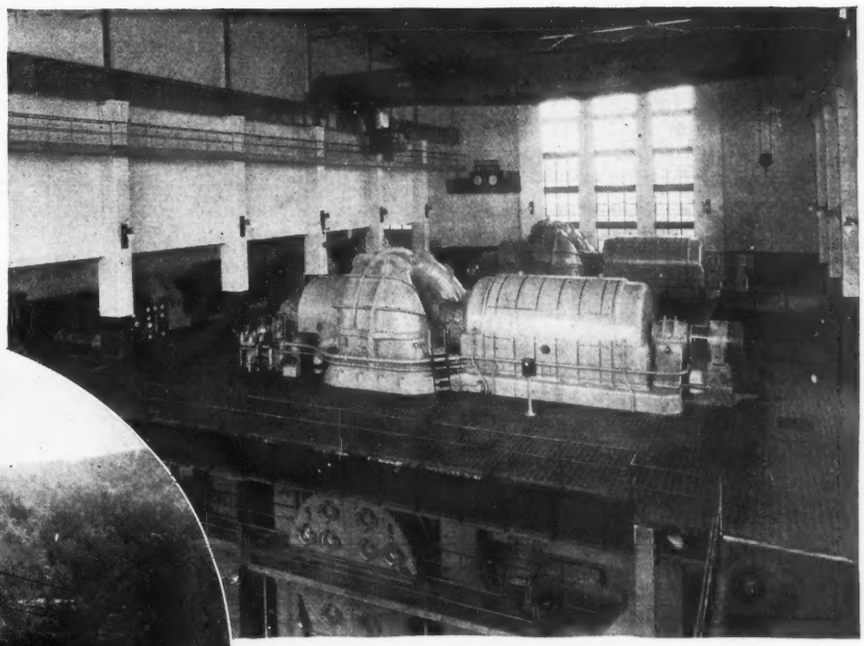
Indian Basin plant of the Great Western Power Company, California, has one 35,000 kw.-unit installed

Delray Power House No. 3 of the Detroit Edison Company is an example of a moderate-pressure plant, designed to give a fair balance between thermal economy and cost per kilowatt of installed capacity. Special stoker-fired boilers serve 50,000-kw. single-cylinder turbine-generators with steam at 400-lb. pressure.

The Detroit Edison Company also has announced plans for the installation of new 75,000-kw. tandem-compound units to replace older units at Connors Creek. The low-pressure end of these units will be installed first and the station later changed over to 600-lb. pressure.

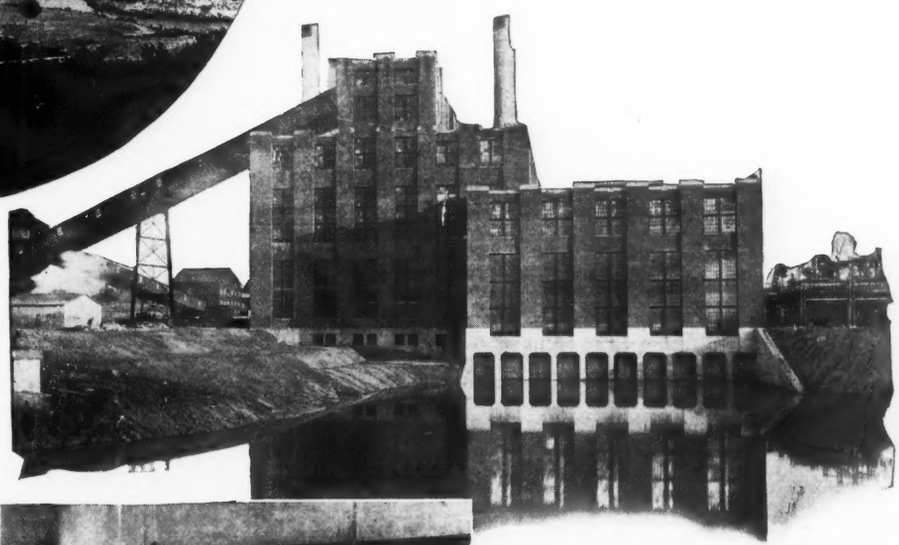
Riverbend steam station of the Duke Power Company, on the Catawba River near Mount Holly, N. C., which is to be operated in connection with an extensive hydro-electric system on an average annual load factor of 40

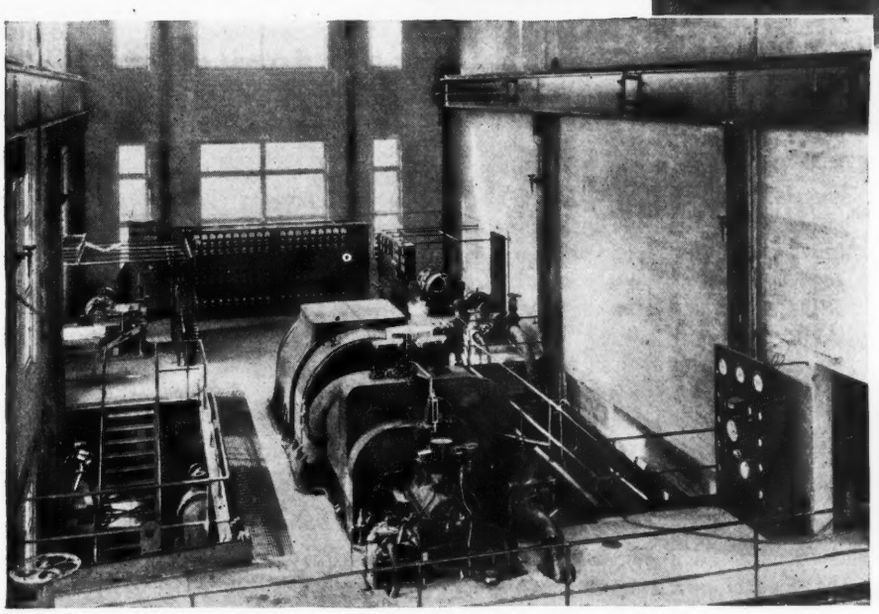
Right — Delray Plant No. 3 of the Detroit Edison Company has two 50,000-kw. turbine-generators. Steam at 400 lb. and 700 deg. is produced by stoker-fired boilers



Above—One 60,000-kw. unit is installed in the new Gorgas plant of the Alabama Power Company. Pulverized fuel and steam at 400 lb. and 700 deg. are used

Below—River Bend plant of the Duke Power Company in North Carolina includes two 55,000-kw. units in the initial installation

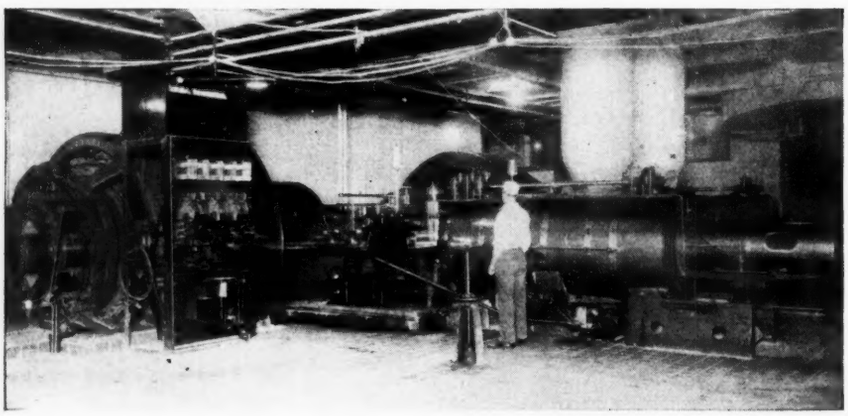




Left—In the new plant of the Gulf States Paper Company at Tuscaloosa, Ala., a 7,500-kw. turbine-generator is installed. The turbine operates condensing and is arranged to bleed 150- and 35-lb. steam for process. Pulverized coal is used. The steam conditions are 450 pounds and 660 degrees

per cent, is an example of a plant for which 425 lb. was selected as the operating pressure after a comparative study with 1,200 and 625 lb. While in these estimates the fuel consumption was 9.7 lower for the 625-lb. pressure and 15.6 per cent lower for the 1,200-lb. pressure, the saving in cost of fuel was entirely absorbed by the increase in capital charges The 425-lb. pressure had the advantages that it involved the lowest initial cost and by permitting complete interconnection of the boilers increased the flexibility. The installation consists of two 55,000-kw. single-cylinder turbine units served by four 35,500-sq.ft. boilers, each equipped with three unit mills.

Other plants of the year adopting conservative pressures in the vicinity of 400 lb. were the new Gorgas steam station of the Alabama Power Company, with its initial 60,000-kw. turbine unit served by two 30,315-sq.ft. boilers fired with powdered coal; the Shuffleton plant of the Puget Sound Power & Light Company, having a 37,500-kw. generating unit and two oil-fired boilers; the Great Western Power Company's plant at San Francisco, with two 450-lb. oil-fired boilers serving a 35,000-kw. turbine-generator that will be used frequently as a synchronous condenser for voltage regulation and for stand-by service; the recently projected steam station of the Buffalo, Niagara & Eastern Power Company that, with its initial 80,000-kw. unit and three 560,000-lb. boilers fired by powdered coal, will operate in conjunction with the Huntley station to supplement hydro-electric power from Niagara; the first section of the English station of the United Illuminating Company, having three 12,500-kw. turbines and six boilers supplying steam at 375 lb. pressure and 150 deg. superheat; and the James H. Reed station being built on Brunot Island in Pittsburgh for the Duquesne Light Company. For the station last named the initial unit will consist of a single-cylinder 60,000-kw. turbine-generator served by three 400-lb. stoker-fired boilers.



Two of the four steam engines in the Hotel New Yorker plant in New York City

This plant has a total capacity of 2,575 kw. of which 2,200 is steam engine driven and 375 Diesel engine driven

So many new plants have been built and so many rehabilitation programs have been carried out in this field, each with its distinctive method of establishing a heat balance, recovering byproduct power from process steam, or increasing the capacity of an existing installation, that detailed enumeration is out of the question. With a few exceptions steam pressures have ranged from 300 to 400 lb. Equipment installed has been modern, and correlation of steam and power loads usually have made possible economies far exceeding those obtainable from the highest types of condensing plant. Only a few typical cases may be cited.

In the new Chicago plant of the Campbell Soup Company power is generated up to the demand for 25-lb. process steam and the balance of the electrical energy is purchased.

At Racine, Wis., in the plant of the Ajax Rubber Company, the installation of a new 425-lb. boiler and a 1,500-kw. turbine bleeding at 170 lb. to the station header and exhausting at 85 lb. pressure to process made possible a power cost per kilowatt-hour of 0.358 cents at full load.

The new Anheuser-Busch plant in St. Louis is being equipped with 465-lb. boilers to supply non-condensing turbines that will generate all the power required while bleeding at 150 lb. to process through an accumulator and exhausting at 5 lb. pressure.

TYPICAL power and process steam installations in textile mills are those in the plants of the P. H. Haynes Knitting Company, of Winston-Salem, N. C., and the Industrial Rayon Corporation's new factory at Covington, Va., both described in the Aug. 27 number.

Paper mills making an excellent showing in combining power and process are the plants of the John H. Heald Paper Company at Lynchburg, Va., and the Rhinelander Paper Company at Rhinelander, Wis. In the former plant are high-pressure boilers fired with pulverized coal, as well as bleeder and back-pressure turbines. At Rhinelander 400-lb. stoker-fired boilers and a 4,000-kw. double-extraction condensing turbine-generator are giving results that indicate a net saving of $100,000 a year over former operation. Representative of paper mill practice is the plant of the Gulf States Paper Company, Tuscaloosa, Ala. In this plant a 7,500-kw. turbine to operate on 450-lb. 200-deg. superheat steam was installed. The turbine operates condensing and is bled at two points to obtain 150- and 35-lb. steam for process.

The new boiler plant of the automotive division of the Mengel Company, of Louisville, Ky., furnishes an interesting example of the efficient use of wood refuse with powdered coal as a secondary fuel.

In the new steel mill plant of the Gulf States Steel Company at Alabama City, Ala., blast-furnace gas is supplemented by powdered coal. Steam at 400-lb. pressure and 700 deg. is supplied to cross-compound turbine-generators and to turbine-blowers, both equipped for steam extraction at three points to heat the feed water. Evaporators provide 150-lb. steam for process. An interesting arrangement is the sale of surplus waste-heat power to the public utility.

For a hotel plant no better example could be found than the New Yorker, described fully in these columns some weeks ago. An outstanding feature is the supplementary use of a Diesel engine to improve reliability and summer heat balance. For the same purposes Diesel engines for Macy's department store in New York have been announced recently. The large savings effected through the rehabilitation of the steam plant and the installation of exhaust steam turbines driving air conditioning equipment were described earlier in the year.

High Steam Pressures

Win General Acceptance

Several central stations for complete 1,200 to 1,400-lb. operation neared completion during the year and others were projected. Work progressed on the 1,800-lb. Philip Carey job. Ford announced a 1,400-lb. plant

FOLLOWING several years of experimentation on a semi-commercial basis, 1929 marked the beginning of extensive commercial development of high-pressure steam plants. Work on the Deepwater and Holland 1,200-1,400-lb. stations, started in 1928, was pushed well toward completion. These will be the first completely high-pressure central stations in America.

Previous installations, such as those at Edgar Station, Lakeside (Milwaukee) and Northeast (Kansas City), employed separate high-pressure turbines exhausting at 350 to 400 lb. to the regular station steam mains.

During the past year work was started also on two other 1,400-lb. stations—South Amboy and station A of the Pacific Gas & Electric Company. Fourteen-hundred pound equipment was ordered for a station in Houston, Texas. A plant on the Pacific Coast, one in San Antonio, Texas, and several others had this pressure under active consideration at the close of the year.

A table of high-pressure industrial plants, compiled by *Power* early in 1929 showed four plants in operation, building or under consideration for pressures above 1,000 lb. Of these only the Philip Carey plant is a complete power-generating installation. This plant is notable for its boiler pressure of 1,800 lb. and for its use of reciprocating engines, of foreign manufacture.

A 1,250-lb. test boiler has been in operation for several years at the Consolidated Ashcroft Hancock Company plant in Bridgeport, Conn. A 1,200-lb. boiler plant for process, in the works of the Masonite Corporation, Laurel, Miss., will be enlarged in 1930, and a 1,500-lb. test boiler plant is projected for the Crosby Steam Gauge & Valve Company in Boston.

In addition, the Deepwater station (1,200 lb.) may be listed as an industrial plant from one point of view, since the entire exhaust output of one of the high-pressure units will be delivered to an evaporator supplying process steam to the neighboring duPont plant. Since this table was published the Ford Motor Company announced the purchase of a 110,000-kw. 1,200-lb. steeple-compound turbine unit, its capacity being divided equally between the high- and low-pressure cylinders. This is by far the largest unit for this pressure. Other industrial plants are studying the possibilities of similar pressures. Near the close of the year comes the report that studies are being made for an installation where steam pressures near the critical will be used in this country. High-pressure steam will be passed through a turbine before going to process.

Last year's table listed six industrial plants, in the range from 600 lb. to 1,200 lb. In the range from 400 to 550 lb. boiler pressure 67 industrial plants were listed. Many of these plants, particularly in the paper industry, bleed steam to process at two or three pressure levels and exhaust the remaining steam to a condenser at moderately high vacuum. Others operate as straight back-pressure plants.

In the range from 300 to 400 lb., 63 industrial plants were listed. Of these, 13 were to be completed during 1929 and two were listed for later completion. This list could be further increased by adding a few plants overlooked in the original survey or announced later.

A similar list of central stations designed or built since 1924 for pressures of 400 lb. or higher, included a total of 41 plants. Plants above 1,000 lb. pressure in this list are Deepwater (1,200 lb.), Edgar (1,400 lb.), Holland (1,400 lb.), Lakeside (1,300 lb.), Northeast (1,400 lb.), South Amboy (1,400 lb.) and Station A of the Pacific Gas & Electric Company (1,400 lb.). To these, as already mentioned, must be added the stations in Houston and San Antonio. Of all these high-pressure stations only Edgar, Lakeside and Northeast were in operation before 1929.

Of the nine plants listed in the range from 500 to 1,100 lb., inclusive, only one—State Line (800 lb.)—was completed in 1929, the rest being of earlier date.

THUS the trend to extremely high pressures in central stations has been marked, while that to intermediate pressures shows a falling off. Maximum temperatures, on the other hand, have remained practically stationary at 750 deg., a temperature limit that was established some years ago. However, the Philip Carey plant, under construction, will use 800 degrees.

While no plants were completed during 1929 for higher temperatures than 750 deg., renewed attention was given to the economic possibilities of such temperatures. Notably, the Detroit Edison Company, after initiating large-scale experiments with piping, valves and fittings subjected to steam temperatures up to 1,000 deg., ordered a 10,000-kw. British turbine for operation at 1,000 deg. and 365 lb. pressure.

It was pointed out during the year that the economic pressure range would be definitely affected by any development that made higher temperatures practicable. The new central stations divided themselves into two groups, one carrying steam pressures up to and including 450 lb. without reheating, and the other employing pressures, with reheating, in the 1,200-1,400 lb. range. It has been found that with a limiting steam temperature of 750 deg., 450 lb. is about the maximum throttle pressure that can be carried without excessive moisture in the lower stages of the turbine.

When, at 500 lb., say, reheating becomes necessary, there is an immediate and substantial increase in the cost of the station. Further rises in pressure, by reducing the amount of fuel and steam to be handled, gradually reduce the station cost until, at 1,200 to 1,400 lb., the cost per kilowatt is only slightly higher than a 450-lb. station. Estimates of excess cost made by prominent engineers vary from zero to $10 per kilowatt, with an average around $5.

THE additional fuel economies obtainable from pressures above the 1,200-1,400 lb. range are, in the opinion of most engineers, too slight to justify further increases in pressure in condensing stations. The successful outcome of high temperature experiments now under way would undoubtedly result in raising the "dead" zone, which now extends from 500 to 1,100 lb., inclusive. Depending on the temperature carried, new stations would find it feasible to raise the pressure up to 500, 600 or 700 lb., without reheating, and thereby gain much of the present fuel-economy advantage of 1,200-1,400 lb. operation. On the other hand, a jump across the "dead" zone to higher pressures might still be advisable, because the efficiency advantage of high pressure increases as the steam temperature rises. In that case the higher steam temperature would raise the economic pressure to 1,800 lb. or higher, depending on the practical temperature limit.

Entirely different considerations have determined the trend of pressure in the industrial plants. There the plant generally started with a given process load, and the problem has been to raise the pressure to a point where practically all of the power needed can be generated as a byproduct. Up to this point enormous savings in fuel are possible. Beyond it there is no advantage whatever except as insurance against future increases in power load.

Many well-designed industrial plants have stopped short of the pressure determined by this criterion for the simple reason that their designers were unwilling to "experiment" with what they considered untested equipment. However, the central stations have thoroughly tried out steam-generating equipment in the 450-lb. range. As a result, pressures from 300 to 500 lb. have proved themselves so attractive that a large number of industrial plants (as already indicated) have adopted them.

On the other hand, the pressure of 1,800 lb., selected for the Philip Carey installation, was determined by the already-mentioned criterion of ability to generate practically all power as a byproduct.

The application of very high pressures to industrial plants has been impeded somewhat by the adverse effect of small size on the cost of high-pressure boilers. The seamless drum required for pressures above 700 lb. costs relatively much more in small units than in large. On the other hand, the far greater fuel saving possible in industrial plants up to the point where all power can be generated as a by-product may soon justify many other high-pressure industrial installations.

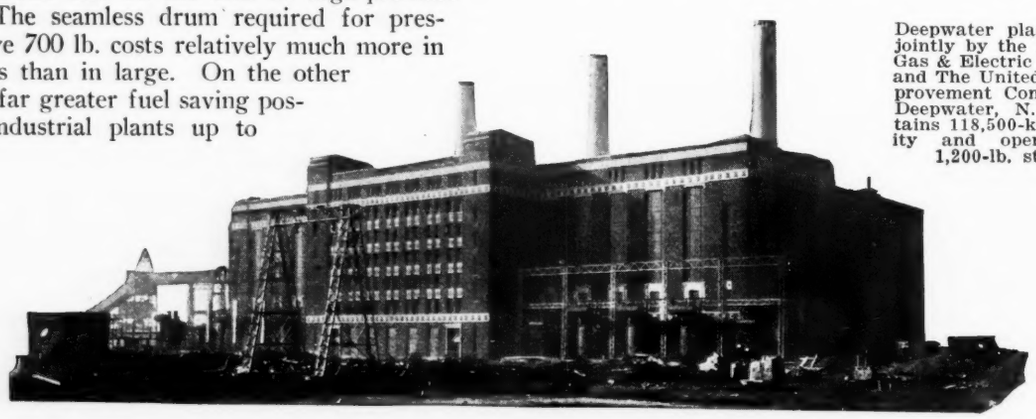
Returning to consideration of the central station, the adoption of high pressures has had a profound effect on the ratio of boiler-heating surface proper to that in economizer, air heater and reheater. The economics of the situation have forced designers to reduce the expensive high-pressure boiler heating surface and increase the economizer and air heater. A contributing factor in this evolution has been the increasing heat of the liquid and decreasing latent heat of steam as pressure is raised. Naturally, this leaves more work for the economizer and less for the boiler proper.

The relatively low cost of high-pressure central stations has resulted from decreases in cost of condenser, building, fuel- and ash-handling equipment, etc., sufficient to offset, practically, the increased cost of the boiler unit proper. Production of high-pressure equipment on a quantity basis is expected to lead to further reductions which may ultimately bring the cost of 1,400-lb. plants below that of 400-lb. plants.

Even in 1929 the excess cost was so little that low load factors and low fuel costs practically lost their significance as arguments against high pressures, so that little was left beyond considerations of reliability. The number of high-pressure installations made and contemplated indicates that the reliability of high-pressure stations, intelligently designed and operated, was not seriously questioned. Experience reported during the year at Edgar Station indicated some trouble with water walls and with feed pumps, but nothing that could not be overcome.

THE American tendency to follow low-pressure practice in the design of high-pressure boilers continued during 1929, in direct contrast to the European practice of designing entirely new types, some without large drums and others lacking drums altogether. The cost of boiler drums forged from solid ingots has been a major item in the cost of high-pressure stations. Comments made during 1929 by engineers interested in high pressures indicated that this will not be a permanent condition. Whether it will be solved by doing away with drums altogether, or by the use of extruded, hammer-forged or autogenously welded drums, is still a matter of conjecture. Possibly all of these may come into use. In any case it has been predicted that there will be a definite reduction in the cost of high-pressure boilers in the not distant future.

All in all, high pressures have become a commercial reality, with every indication of rapid developments.

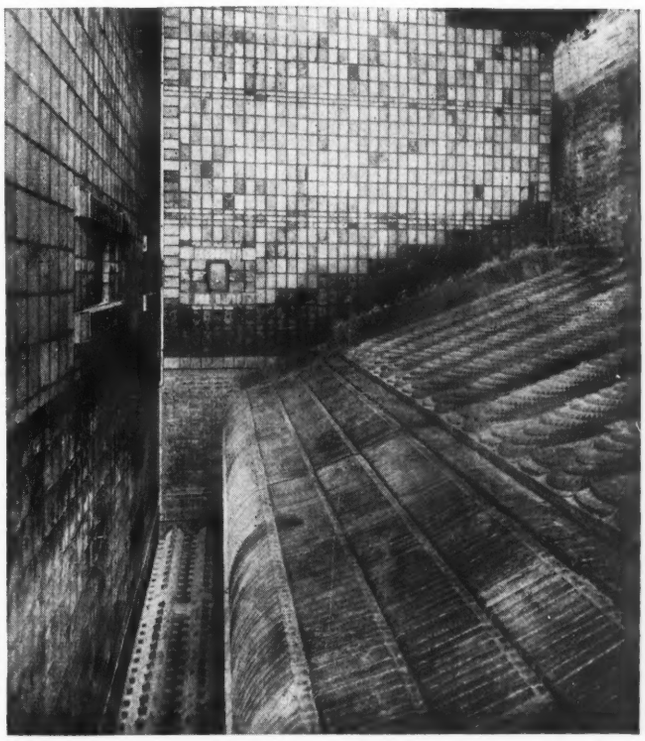


Deepwater plant owned jointly by the American Gas & Electric Company and The United Gas Improvement Company, at Deepwater, N. J., contains 118,500-kw. capacity and operates on 1,200-lb. steam.

BOILER ROOM EQUIPMENT

Reveals Steady Progress

Bigger boiler units, increased fuel-burning rates, closer attention to feed-water treatment and further development in high-pressure boiler design mark the trends in boiler-room practice



Thirty-three-tuyère stoker at Hudson Avenue

DURING the past year there has been a general improvement in design details of practically all boiler room equipment, but no radical changes were made. Unit boiler capacities have increased rapidly until the million-pound per hour unit is here. In fact, one of the new boilers at the East River station in New York has turned out 1,250,000 pounds of steam per hour. Competition between stoker and pulverized-coal equipment continued to promote mechanical improvements in both fields.

The adoption of steam pressures in the 1,200-1,400 lb. range in a number of new stations has not brought out any great changes, and in America the elements of high-pressure boilers have continued to follow the design of low-pressure units except for solid forged drums, heavier tubes and minor changes. On the other hand, allocation of total heating surface in such units has shifted to the point where boiler heating surface proper is only about 12 per cent of the total.

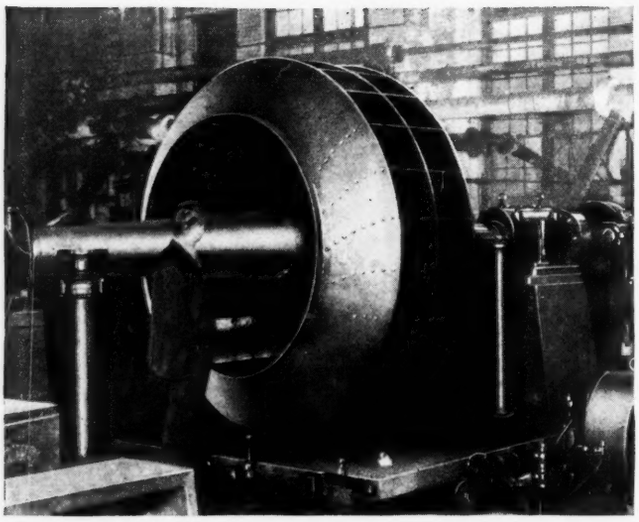
The influence of the cost of high-pressure boiler surface on heating surface distribution, and on capacity per square foot of boiler heating surface is illustrated by figures for units installed in the Holland and the South Amboy 1,400-lb. stations. For example, the 7,900 sq.ft. of boiler-heating surface in each unit at Holland is only twelve per cent of the unit total, the superheater accounting for 6.9 per cent, gas reheater 17.2 per cent, economizer 17.6 per cent, and air heater 46.3 per cent. In this plant each square foot of surface supplies 2.94 kw. The corresponding figure for South Amboy is 3.4 kilowatts.

High preheat, in turn, with high operating rates make water walls a practical necessity. A recent development has been the application of the forced-circulation Riley La Mont boiler to water-wall service. One of the advantages claimed is that the tubes can be placed in any position without interfering with the circulation. Several methods have been developed to reduce the amount of slagging on the first bank of tubes. In the bent-tube boiler, for example, every other front tube of the front bank is bent in such a manner that alternate tubes of this row are in a different plane.

Greater attention has been given to the protection of superheater headers. This has been secured in some cases by baffles, but in the more recent installations the headers have been located above the boilers and entirely outside of the boiler setting. One manufacturer has changed its superheater design to the multi-bend-type and has provided Y fittings to permit cleaning.

In heating surface and steaming capacity the largest boiler units installed in 1929 were three bent-tube boilers placed in the East River Station of the New York Edison Company. Each of these has a boiler-heating surface of 60,706 sq.ft., and a water-wall surface of 7,345 sq.ft. Economizers are integral with the boiler, which with the water screen, has eleven drums. They are fired with pulverized coal (central station).

One of the important boiler installations made during the year was that of the new Gorgas Station of the Alabama Power Company. Each boiler in this plant contains 30,315 sq.ft. of boiler-heating surface. Built for 477-lb. pressure, the boiler drum is 34 ft. $2\frac{3}{4}$ in. long and 72 in. in diameter, the largest ever constructed



Gorgas plant has largest induced-draft fan

for this pressure. In trial runs an output of about 500,000 lb. of steam per hour was developed.

At the new Delray plant of the Detroit Edison Company units having a capacity of 340,000 lb. of steam per hour were placed in operation during the year. The convection elements of these boilers are similar to those of Stirling type. In addition, each unit has an independent screen boiler consisting of four water walls and one bank of tubes crossing the top of the furnace. The latter acts as a screen for the superheater. This screen boiler, which, with the fuel bed, entirely incloses the furnace, is independent of the main boiler and has its own circulation.

The Ford installation, announced late in the year, will be outstanding. These boilers will be capable of generating 700,000 lb. of steam per hour each at 1,400-lb. pressure, thus exceeding in capacity any yet built or projected for this pressure, either in private plants or central stations. Each boiler will be fired by twelve tangential pulverized coal burners, with one burner for blast-furnace gas.

Industrial plant boilers, in general, have increased in size and are being operated at higher rates than formerly.

Fuel Burning Equipment and Furnaces

In large plants the tendency toward pulverized coal has continued, although several noteworthy stoker installations have been made. The unit system is still the more widely used in the industrial field, and has been making headway in central stations, although the bin system still predominates there. Pulverizing mills in capacities up to 25 tons per hour are in operation, and some plants are using as many as five mills per boiler. Combustion rates vary from 18,000 to 30,000 B.t.u. per cubic foot in the ordinary water-cooled furnaces, but rates as high as 42,000 B.t.u. have been attained in some slag-tap furnaces.

Successful experience with slag-tap furnaces at the Charles R. Huntley station, Buffalo, N. Y., and at the Toronto station, has led to similar installations.

Pulverizers have been improved to give smoother operation and greater capacity and to consume less power. An interesting development was a duplex pulverizer consisting essentially of two single units mounted on one shaft with feeders at both ends and discharge fans in the middle.

During the year there occurred a number of pulverized-coal-furnace explosions, a few accompanied by fatalities, but the greater number involving minor damage. These explosions were in most cases attributable to a disregard of operating instructions and were not a reflection on the method of firing.

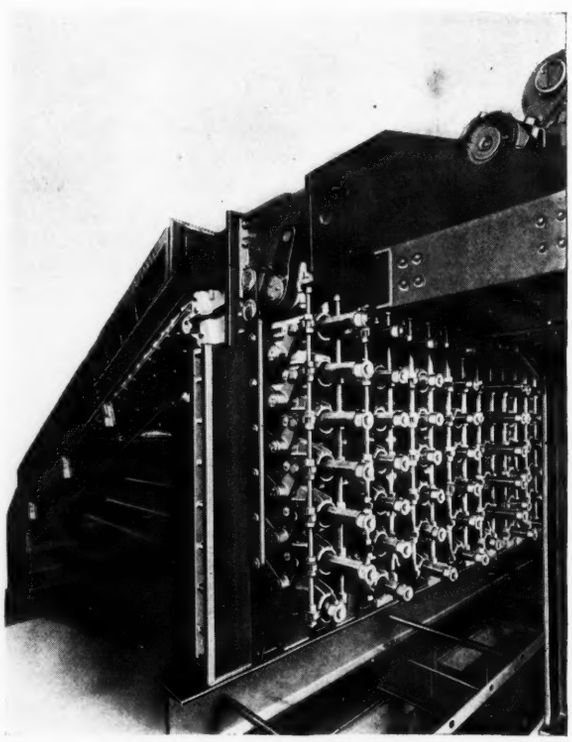
Devices for reducing the nuisance of dust from the stacks and separator cyclones of pulverized fuel plants have come into increasing use. The Detroit Edison Company reported extremely satisfactory results with a device using cloth bags and mechanical shaking to remove the coal dust discharged by cyclone separators. For the removal of fly ash from stacks, the electro-static precipitator is still the most effective device. However, the use of simpler mechanical devices is extending.

During the year the second pulverized-coal-burning vessel of the United States Shipping Board was placed in operation after a successful trial trip. The pulverizing equipment of the West Alsek is radically different from that installed on the Mercer. Each furnace of the three-furnace, Scotch Marine boilers is served by its individual mill, which delivers fuel to a turbulent-type burner. The mills are turbine-driven in groups of three.

The development of stokers, in capacity, efficiency and reliability, that took place during 1928 has continued. In spite of the popularity of pulverized coal, sales of stokers set new records during the year. Single stoker units are now available to supply fuel for a steam production at 500,000 lb. per hour.

Several new stokers were developed during the year. One, an underfeed, combines increased length with effective fuel movement by a new undulating movement of the area beyond the tuyeres. Another applies a straight-line drive to eliminate side thrust on rams and thus reduce wear.

Among the interesting stoker orders of the year were four of 33 tuyeres for 24,320-sq.ft. boilers in the



Type of stoker installed at the new Delray plant

Hudson Avenue station of the Brooklyn Edison Company, and an 18 ft. x 19 ft. chain-grate stoker to burn anthracite in a plant at Johnstown, Pa.

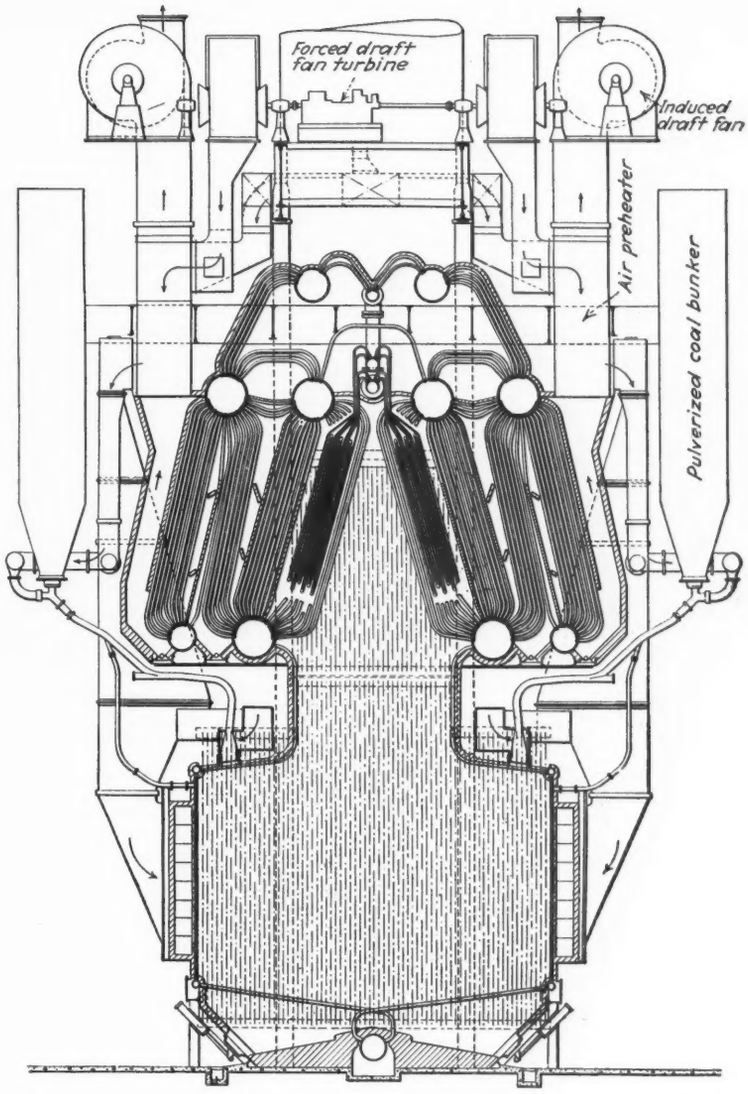
The most outstanding stoker installation of the year was that in the new Delray plant of the Detroit Edison Company. These stokers, which were placed in regular operation during the year, are 15 retorts wide, 57 tuyeres long, and are capable of burning 17 tons of coal an hour. They are equipped with automatic air-control dampers to regulate the air supply to the stoker sections.

Manufacturers report several orders for American fuel-burning equipment, outstanding among which are the underfeed stokers ordered for the West Central Station, Berlin. These stokers have 20 retorts, 49 tuyeres long and are expected to burn sufficient coal to produce 600,000 lb. of steam per hour. Air for combustion will be preheated to 500 deg. F.

While maximum operating steam temperatures have remained practically constant at 750 deg., experiments initiated during the year by the Detroit Edison Company point the way toward higher temperatures, with a resulting profound effect on the pressure range. In these experiments it is expected that steam will be taken from the regular station superheated main and raised to 1,000 deg. in a separately fired superheater.

The foregoing installation is frankly experimental. Few engineers expect to reach anything like 1,000 steam temperature in commercial operation in the near future. However, there is a distinct possibility of an early trend to 800 or 850 deg. in some stations.

The year has seen only detail changes in economizer design. However, the economizer has continued to stage a comeback in that it is now installed without question in most high-pressure stations. Higher pressures have increased the importance of feed-water heating while decreasing that of evaporation.



This boiler at "East River" has evaporated 1,250,000 lb. per hour

The air heater has been increasingly used both with and without an economizer. Some users have reported difficulties due to corrosion at the exit-gas end, others have had no trouble. Three principal factors seem to be involved: final temperature, coal composition and operating conditions. In general, the corrosion has occurred where a low temperature of the exit gases has coincided with the use of a high-sulphur fuel. However, cases of severe corrosion have been reported with low-sulphur fuel.

Feed pumps have experienced a notable development as a direct result of the growth of high-pressure power plants. When the steam pressure rises from 400 lb. to 1,200 lb. feed pumping requires approximately three times as much power. Increased motor size and the desire to use alternating current drives has made speed regulation difficult and expensive. High pressure presents the pump designer with other difficulties, such as leakage, thrust and maintenance of efficiency.

Designers have made definite progress in overcoming these difficulties. In some cases the difficult problem of speed control has been dodged entirely by running the high-pressure pump at constant speed and concentrating the entire control in a preliminary low-pressure pump provided with variable-speed control. This arrangement will be used at Deepwater.

Large capacity boilers and the use of both economizers and air preheaters have required increases in fan capacity and pressure. The largest induced-draft fan reported in operation is at the Gorgas plant of the Alabama Power Company. Each 30,315-sq.ft. boiler is served by one fan of 358,000 c.f.m. capacity at 18 in. static pressure. The fans are each driven by two motors, one of 900 hp. and the other of 1,800 hp., and are equipped with vane control.

Phosphate and sodium aluminate treatments have come into increasing use. It is claimed that the phosphate treatment requires less soluble salt less excess chemical, gives less foaming and less scale.

The most knotty problem in the field of feed water relates to the so-called "caustic embrittlement." This is still the subject of much argument, but it is generally agreed that embrittlement can be prevented by maintaining a sulphate or phosphate carbonate ratio rising with the pressure. In some cases, particularly in industrial plants, the maintenance of the proper ratio is so difficult that a strong demand has arisen for welded boiler drums as a method of preventing embrittlement.

STEAM PRIME MOVERS

Trend Toward Larger Units

Steeple compounding for high pressure units, welded turbines and condensers, increasing use of steam engines and steam driven auxiliaries and large sized units all indicate the trends in the application of steam prime movers.

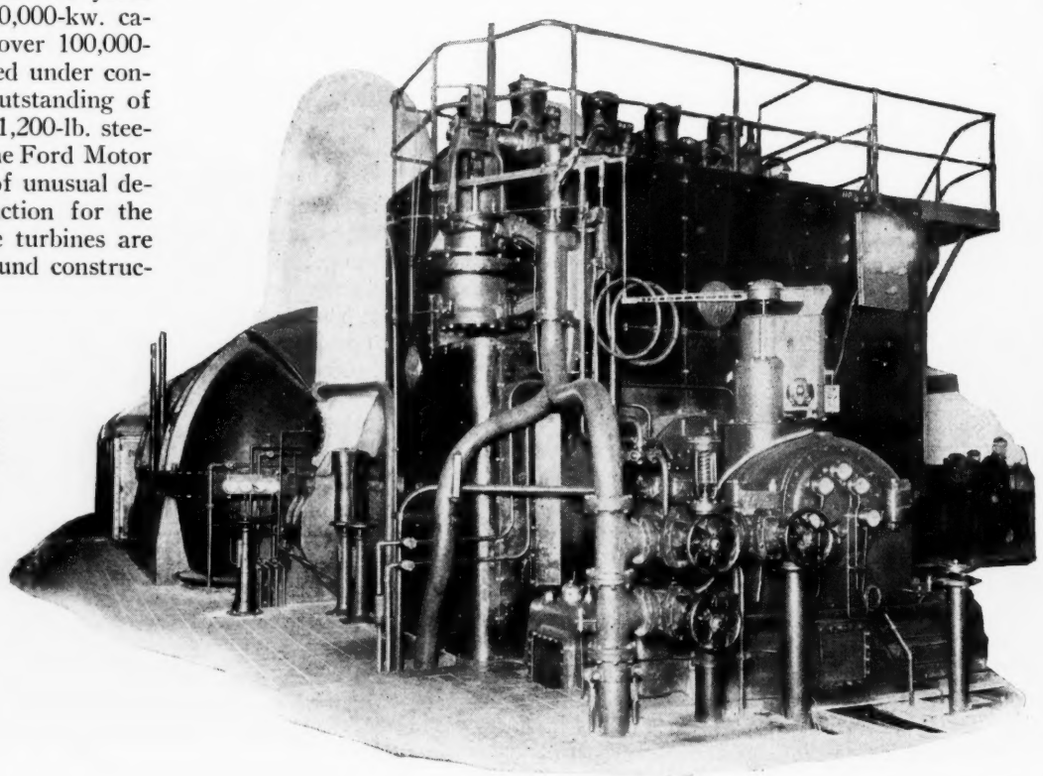
CONTINUING the trend of 1928, there were placed in operation during 1929 three super-capacity turbine-generators. The largest of these, the largest unit in operation in the world today, is the 208,000-kw. tripple cross-compound unit at State Line Station. This unit, operating with steam at 650 lb. pressure and 750-deg. temperature, consists of one high-pressure and two low-pressure cylinders. Each low-pressure cylinder exhausts to four single-pass condensers.

The other large units placed in operation during the past year are the 165,000-kw. cross-compound turbine installed at the Hell Gate Station of the United Electric Light & Power Company, and the 160,000-kw. tandem-compound unit at the East River station of the New York Edison Company. This is the largest tandem-compound turbine in operation and drives the largest double-winding generator. There have been placed in operation within the last two years seven units of over 100,000-kw. capacity. Four units of over 100,000-kw. capacity are reported under construction. The most outstanding of these is a 110,000-kw., 1,200-lb. steeple-compound unit for the Ford Motor Company. Two units of unusual design are under construction for the Powerton station. The turbines are of triple tandem-compound construction and drive a single double-winding generator of 105,000-kw. capacity. They will operate on steam at 600 lb. pressure and 725 deg. temperature. A tandem-compound unit driving a 115,000-kw. single-winding generator is under construction for Waukegan.

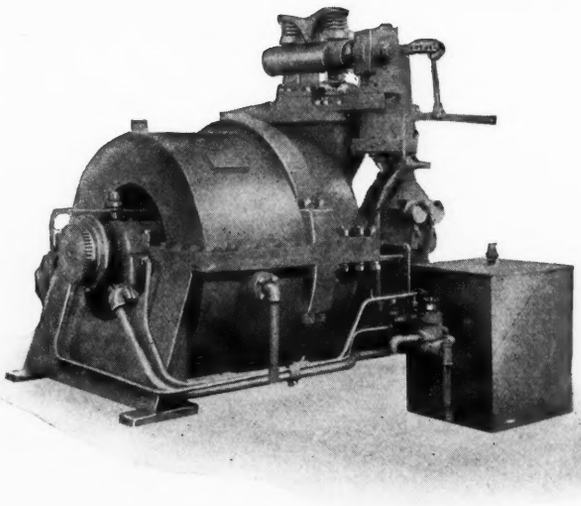
The largest single-cylinder turbine in operation is the 75,000-kw. machine in the Huntley Station of the Buffalo General Electric Company. This will soon be superseded by an 80,000-kw. single-cylinder unit now under construction for the same company.

Design improvements in the double-rotation radial-axial-flow turbine include a change in the method of fastening the blades in the blade ring. A 50,000-kw., 1,500-r.p.m. unit is now under construction for installation at Västeräs, Sweden.

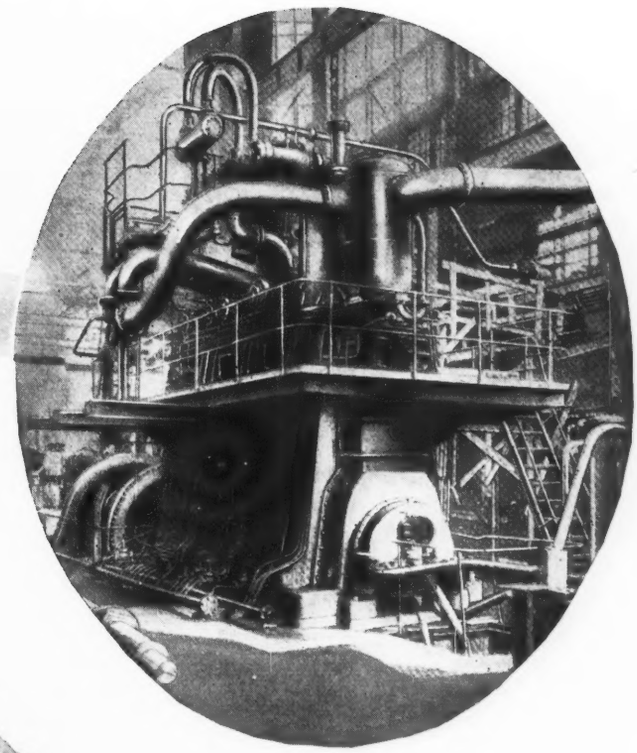
The eleven turbines on order for 1,200-lb. pressure are evidence of the decided trend to higher pressures. They



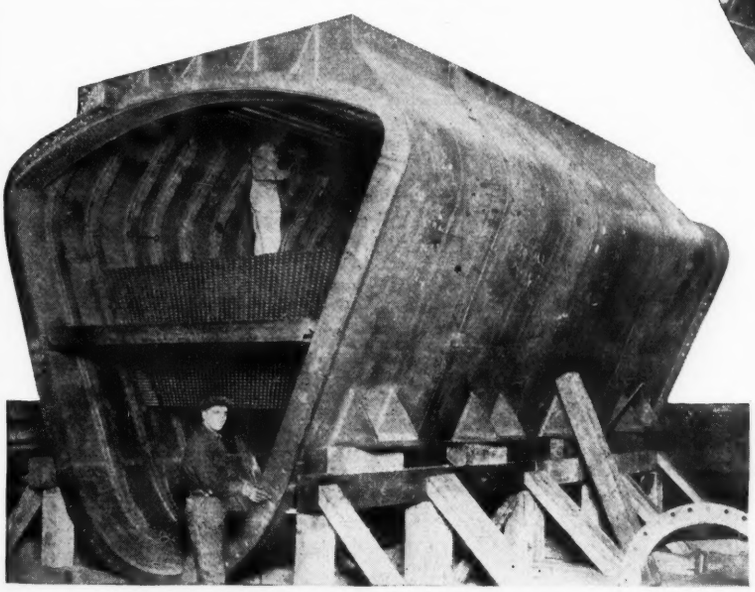
The 160,000-kw. tandem-compound unit operating in the East River Station, New York City.



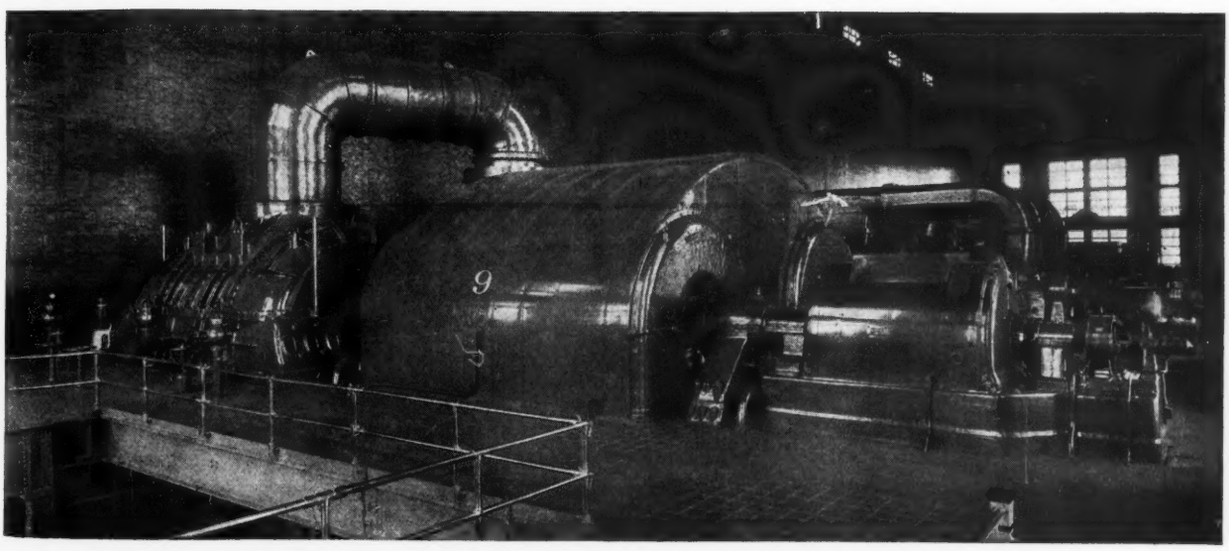
Above—One of the four turbines built with welded steel-plate casing rated at 1,000 hp., and drives a circulating water pump



Above—One of the 6,000-hp. triple-expansion vertical engines for the 1,800-lb. Philip Carey plant



Left—First welded condenser for stationary practice. It is serving a 30,000-kw. turbine at the Parr Shoals plant



The 165,000-kw. cross-compound unit at Hell Gate, New York City

are for installation in seven plants, three of which are new stations. In the high-pressure field the steeple-compound turbine is an outstanding development. Five units of this type are on order or under construction. Two are of 25,000-kw. capacity, for installation at the 1400-lb. plant of the New Jersey Central Power & Light; two are of 50,000-kw. capacity for installation in Station A of the Pacific Gas & Electric Company, which is being rebuilt for 1,200 lb. pressure; and the 110,000-lb. Ford unit previously mentioned.

High pressure is largely responsible for the development of steeple-compounding. With pressures of 1,200 lb. the high-pressure cylinder becomes sufficiently small in comparison with the low-pressure unit to make its installation above the low-pressure unit a practical design. The desire to economize in floor space has also contributed to this development.

THE Ford unit is the largest of this type and is also the largest industrial unit and the largest high-pressure unit. Each element is of 55,000-kw. capacity and the turbine cylinder of the high-pressure element is supported on top of the low-pressure cylinder. The high-pressure turbine has twelve stages, and each half of the double-flow low-pressure turbine has ten stages. Both elements operate at 1,800 r.p.m. The unit will develop about 83 kw. per square foot of floor area.

The other steeple-compound units under construction differ from the Ford turbine in that the high-pressure turbine and generator are supported on top of the low-pressure generator. The high-pressure elements of the units for the New Jersey Central Power & Light operate at 3,600 r.p.m. and generate approximately 25 per cent of the unit's total capacity.

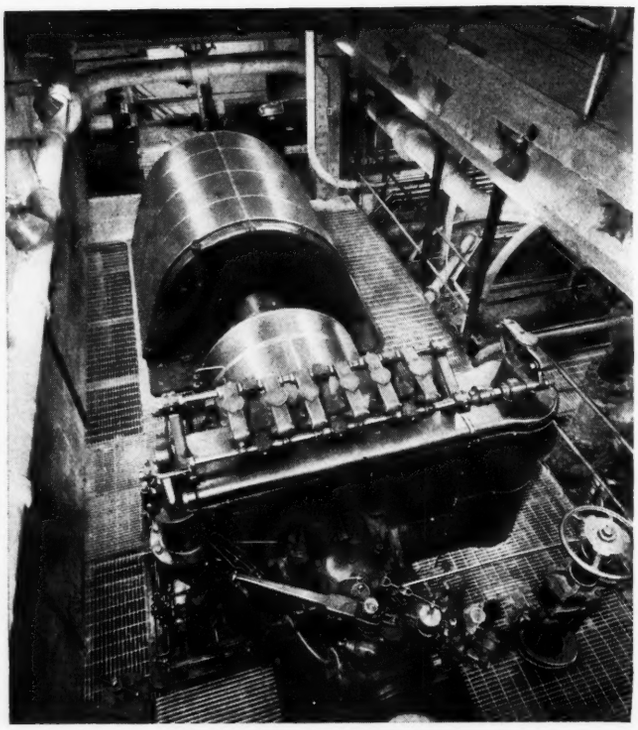
One of the salient announcements of the year was that made by the Detroit Edison Company regarding the purchase of a 10,000-kw. turbine from England to operate with steam at 365-lb. pressure and 1,000-deg. temperature. This installation, at the new Delray plant, is admittedly an experiment to determine the performance of valves, pipes and fittings under such extreme steam conditions. While as yet there is no other discernible trend toward temperature over 750 deg., except the Philip Carey Plant, which will employ 800 deg., nevertheless this trial indicates the thought that is being directed in that direction.

The first unit at Deepwater, which is one of the first two stations to be designed exclusively for high pressures, is expected to be placed in operation during the latter part of this month. Two 53,000-kw. cross-compound turbines make up the main generating equipment, while a 12,500-kw., 1,200-lb. single-cylinder non-condensing unit will supply process steam to the neighboring duPont factory.

A 12,000-KW. turbine for 1,300 lb. pressure has been ordered by the Houston Light & Power Company. It will exhaust at about 380 lb. to the station header, which supplies steam to four other turbines.

As a further indication that high pressures are not confined to central stations, the Dow Chemical Company has ordered from American Brown-Boveri a 3,700-kw. single-cylinder turbine designed for 1,400-lb. pressure and exhausting at 360 lb. It is the first 1,400-lb. unit this company has undertaken to build.

Except for the development of the steeple-compound turbine and large-size units, changes in design have been mostly restricted to details. There appears to be a trend



Automatic 5,000-kw. unit at Rochester, N. Y.

back to the use of a larger number of governing valves.

Some improvements have been made in blading design. Some manufacturers are now carefully rounding and polishing blade edges, by which expedient the fatigue resistance of the blades is increased in the ratio of about 3 to 1. Similar attention is being given to the method of fastening blade lacing. There has been no notable change in blade materials.

A few failures of bolting in the high-pressure and temperature region have resulted in the use of chrome-nickel steel for this service. In some cases the studs have their axes drilled with stepped measuring holes that permit a heating element to be inserted to give the studs proper stretch and to allow entry of a micrometer for measuring the stretch of the steel.

THAT industrial plants are taking advantage of higher pressures is evidenced by the demands for high back-pressure and extraction-type turbines for supplying steam to process or to the low-pressure mains. These units are being built to more definitely fit the requirements for which they are purchased.

Multi-stage small turbines are being used increasingly in the range from 50 to 300 hp., with a resulting increase in economy. A decided trend back to turbine drives for power plant auxiliaries is reported by one manufacturer. Three large central stations now under construction are installing steam auxiliaries.

Automatic control devices are being applied more generally to the small turbine. These include automatic jet control, as well as remote control of speed. A noteworthy installation of fully automatic turbine operation has been made in Rochester. The load back-pressure and extraction pressure are all under automatic or remote control, and in addition safety devices have been included that make it possible to operate without attendants.

A notable departure in turbine construction was made by one manufacturer, who has furnished to the New

York Edison Company a unit with an arc-welded casing of plate steel. This unit is of 1,000-hp. capacity designed for non-condensing operation on 400-lb. steam. It drives an 80,000-g.p.m. circulating pump through reduction gearing. The turbine and gearing are supported on a bedplate of welded structural steel. Four other machines embodying this construction have been built.

Engine designs have been fairly well established by tradition and usage, but during the year a steam engine company introduced commercially a radical valve gear for its uniflow engines, especially for the vertical designs, which gives a constant lead.

Six 2,000-hp. uniflow engines with this type of gear have been ordered for installation on Mississippi River barges. This may be taken as indicative of a trend back to the steam engine for river boats, in spite of the general assumption that the oil engine offers economies in this service.

Since the war new office and hotel buildings have generally depended upon outside sources for power. During 1929 there has been a re-examination of the economies obtainable through generating power when large amounts of steam are needed for heating and cooking, and as a result many public buildings have installed power plants. Outstanding in this practice is the New Yorker Hotel.

The two vertical 6,000-hp. triple-expansion engines purchased from A. Borsig of Berlin, Germany, by the Philip Carey Company for operation with 1,455-lb. pressure and 797-deg. steam have been tested by the maker. As 1,400-lb. steam was not available, the test was run with 867-lb. steam heated to 797 deg.F. These engines consist of two single-acting high-pressure cylinders, two single-acting intermediate cylinders and one double-acting low-pressure cylinder. The high- and intermediate-pressure cylinders are tandem-compound. Both engines have been shipped. One has been erected and should be ready for operation in the spring.

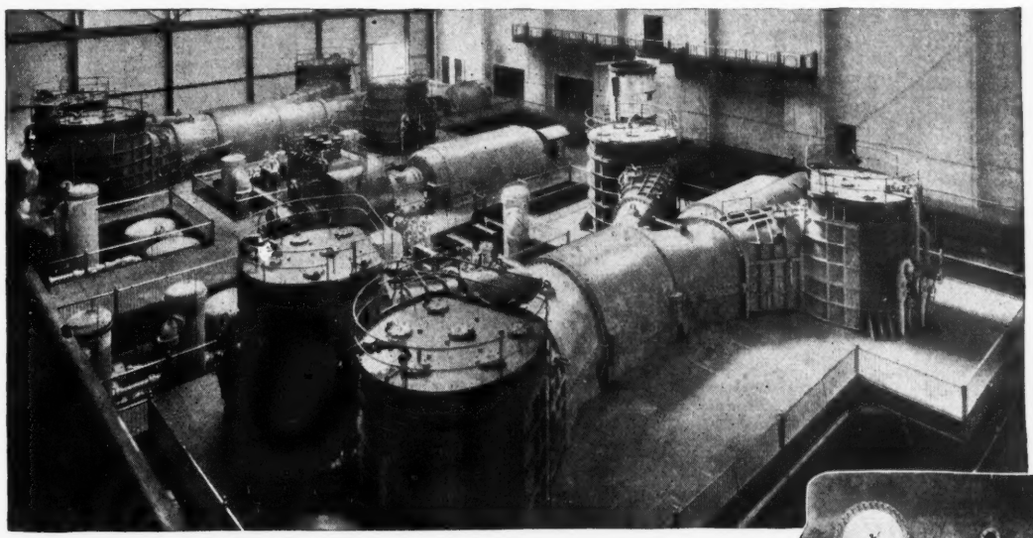
Increased use of the single-pass condenser and a further decrease in amount of condensing surface installed per kilowatt of turbine capacity mark the general trend of condenser design. Several stations have installed condensers with 0.8 sq.ft. of surface per kilowatt. One station is designed for 0.575 sq.ft. per kilowatt of turbine capacity.

There has been a more general use of condensers with tubes rolled in at both ends. Four methods of providing for the expansion of the tubes and condenser shell have been developed. These include various floating tube sheet and water box constructions and tube support sheet designs that permit expansion to be absorbed by tube flexibility.

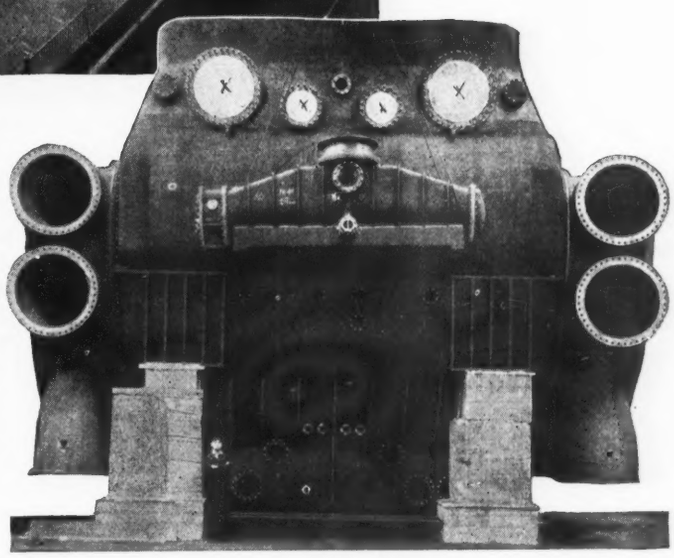
During the past year the first large all-welded surface condenser for stationary practice was built and installed at the Parr Shoals plant of the Broad River Power Company. This condenser, of double-single-pass construction, has 27,000 sq.ft. of condensing surface and serves a 30,000-kw. unit. The shell is made of copper-bearing $\frac{7}{16}$-in.-thick steel plate supported by ribs, as shown in the construction picture. The corresponding thickness of cast iron would have been of the order of $1\frac{1}{4}$ to $1\frac{1}{2}$ in., indicating the decrease in weight secured by welded construction. This feature was of particular importance, as basement conditions made it desirable to support the condenser shell entirely from the turbine exhaust flange, which the lightness of the welded construction permitted.

Greater attention is being paid by several manufacturers to longitudinal distribution of steam in the condenser. Some improvement in this direction has been secured by using the tube support sheets to divide the condenser into sections and providing separate air removal connections for each section.

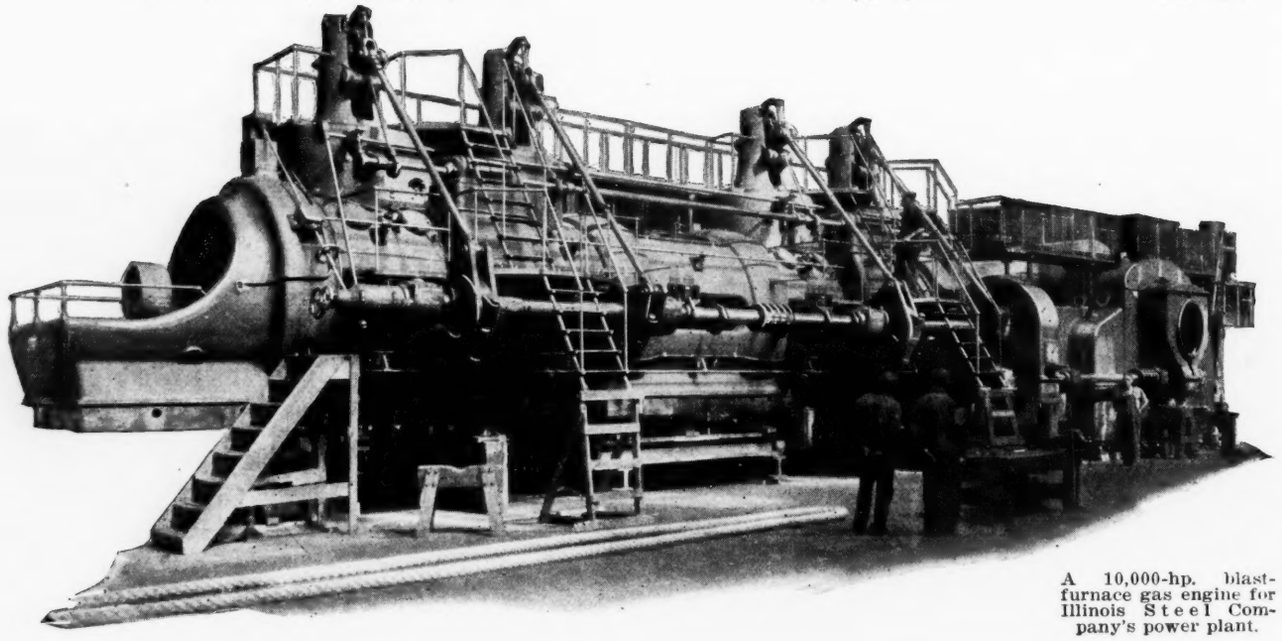
Reports of tests made at Kearny indicate that chlorine has been successfully used to prevent slime from forming on condenser tubes. The chlorine is injected into the circulating water at definite intervals to kill the algae that hold together the mud and silt to form slime.



Three-element 208,000-kw. unit at State Line



This 90,000 sq.ft. surface condenser serves the 160,000-kw. unit at East River



A 10,000-hp. blast-furnace gas engine for Illinois Steel Company's power plant.

GAS and OIL ENGINE HISTORY of 1929

NOT NEW DESIGNS but wider application has been the outstanding feature of the oil and gas engine industries. A large number of Diesel central stations were installed during the past year, and many extensions were made to existing plants. The Tucson (Ariz.) Gas & Electric Company, which already had four 500-hp., two 1,000-hp. and one 3,750-hp. Diesels, installed a second 3,750-hp. unit during the year. This plant is exceptional in that all the cylinder air is passed through a water spray for cleaning, the resulting increased air density giving a greater overload capacity.

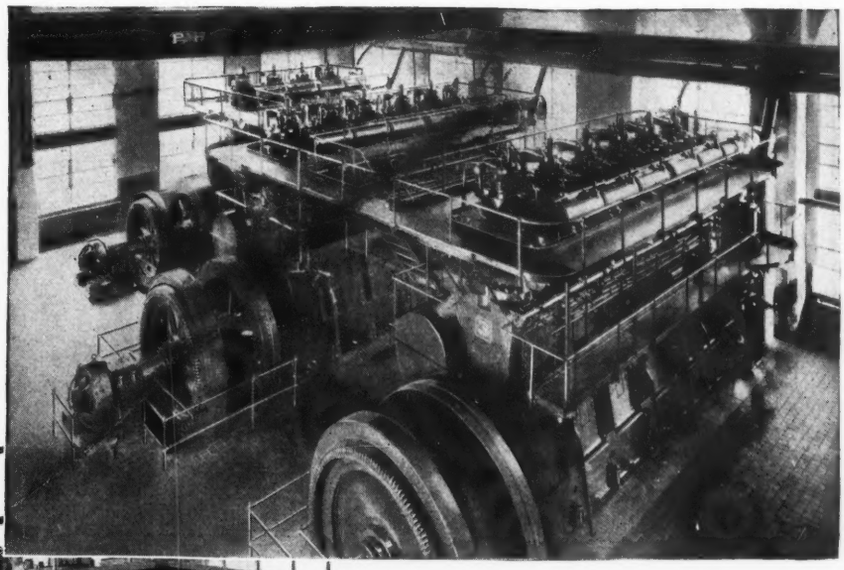
Other large Diesels for central stations include a 3,750-hp. unit ordered for installation in the Cardin, Okla., plant of the Commerce Mining & Royalty Company. This plant already contains 6,750 hp. of Diesels and serves a series of zinc mines in Oklahoma and Missouri. The Texas-Louisiana Power Company has ordered a 2,400-hp. eight-cylinder 21x24 in. engine for its Pecos, Texas, plant and has completed the rebuilding of its Silver City, N. M., plant, the latter now containing over 2,000 hp. of Diesels. Other western installations include the Ellis, Kan., municipal plant, in which a 350-kw. unit was installed, and the Forrest City, Ark., plant, which now is powered by a new 560-hp. two-stroke-cycle Diesel, and two older units.

Turning to the East, notice must be taken of the Rockville Center, L. I., municipal plant, which put into operation 4,600 hp. of four-stroke-cycle air-injection Diesels. Also the Freeport, N. Y., municipal plant, which increased its Diesel capacity of 4,165 horsepower by a 1,500-hp. unit.

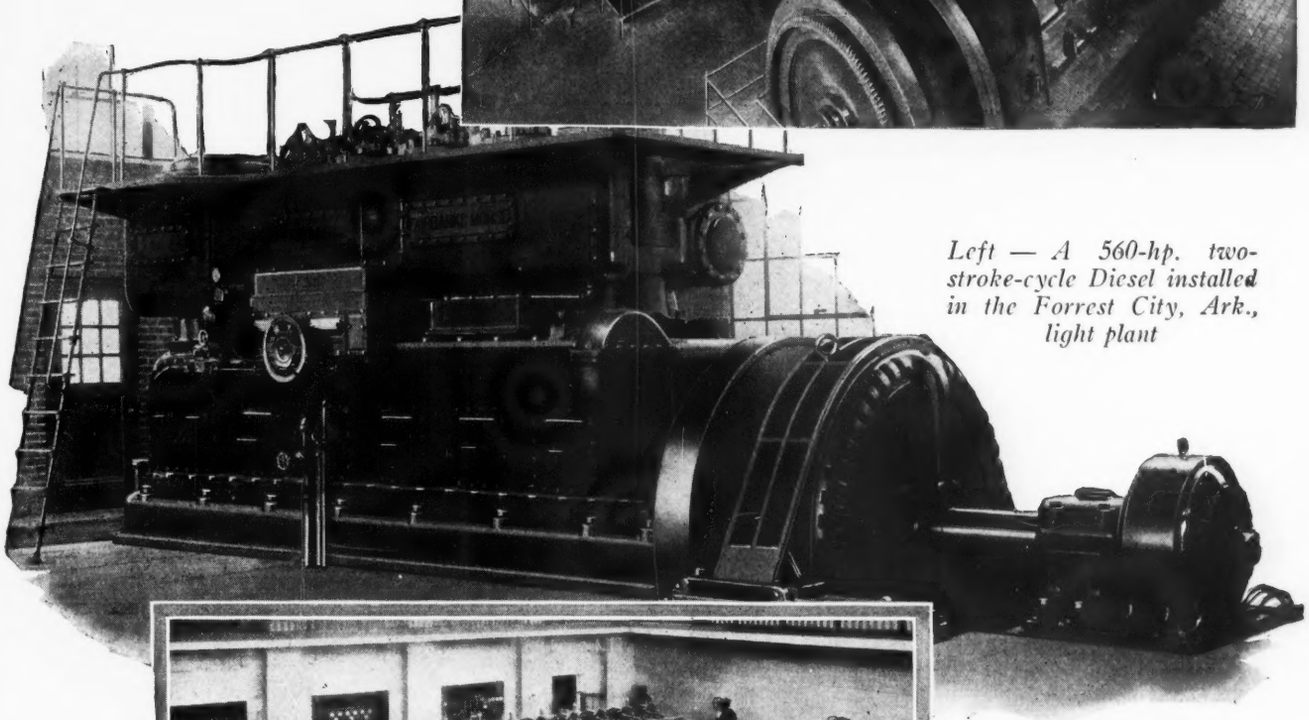
Several events occurring during the year have caused owners of office and hotel buildings to give serious attention to the Diesel for operation in conjunction with steam units. A spectacular installation of this kind was a 375-kw. Diesel in the New Yorker Hotel. This unit, while intended primarily as breakdown insurance, will be operated during the non-heating season. A second installation of somewhat similar character will consist of two 1,000-hp. Diesels ordered by R. H. Macy & Company, New York's largest department store. In this plant the power load exceeds the low-pressure steam demand even in winter.

Industrial installations have been made in silk mills, mines, quarries, flour mills and other factories. However, there is as yet no general acceptance of the large Diesel for industrial power, save in the mining field. This is due, of course, to the necessity for low-pressure steam in many plants, which makes steam units economical, and to low power rates in certain districts.

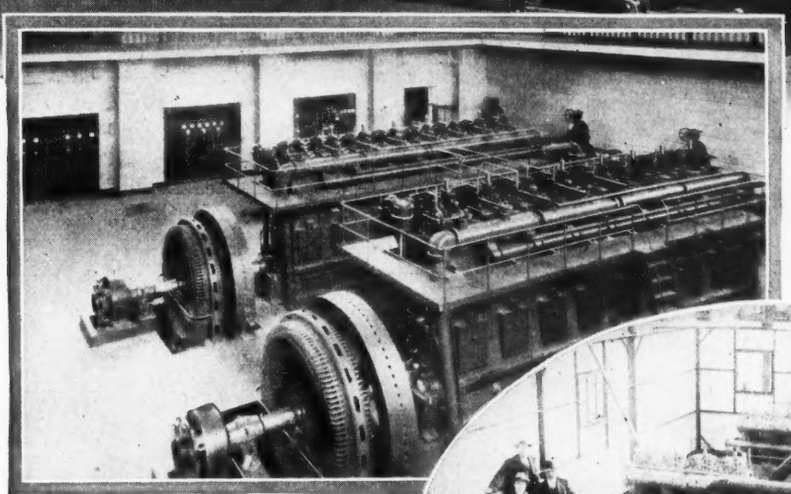
Diesels for water-works have become a standard application. During the year Saginaw, Mich., installed two 1,200-hp. Diesels in its water-pumping plant. So far the units have acted as stand-by power, energy being purchased; but it is claimed that whenever the electric rate is advanced, the Diesels will be put into regular service. In the meantime, their presence, providing breakdown service, gives Saginaw a low fire insurance rate. A water plant that uses Diesels for its sole power is that of Port Washington, N. Y., which recently installed a 300-hp. Diesel as an addition to the present three engines.



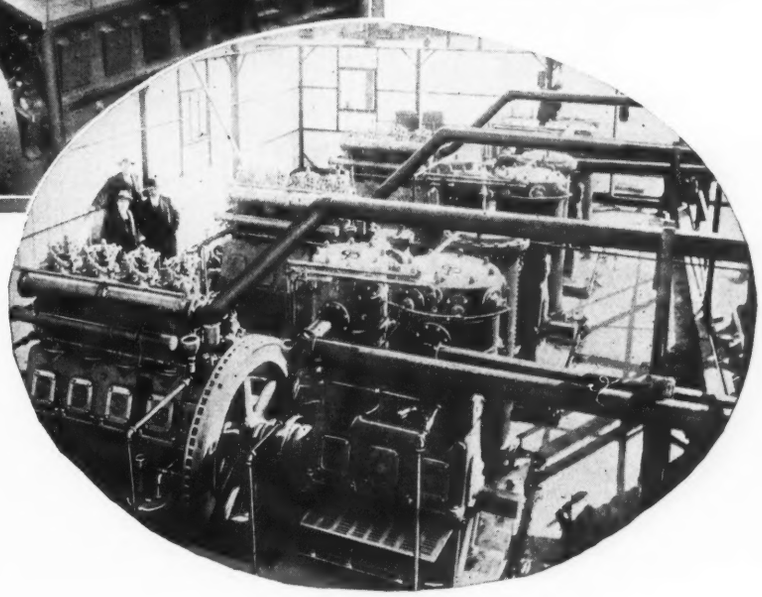
Right — Two 1,250-hp. and one 900-hp. four-stroke-cycle Diesels in the Rockville Centre, N. Y., municipal light plant



Left — A 560-hp. two-stroke-cycle Diesel installed in the Forrest City, Ark., light plant



Left—Two Diesels used as stand-by in the Saginaw, Mich., waterworks



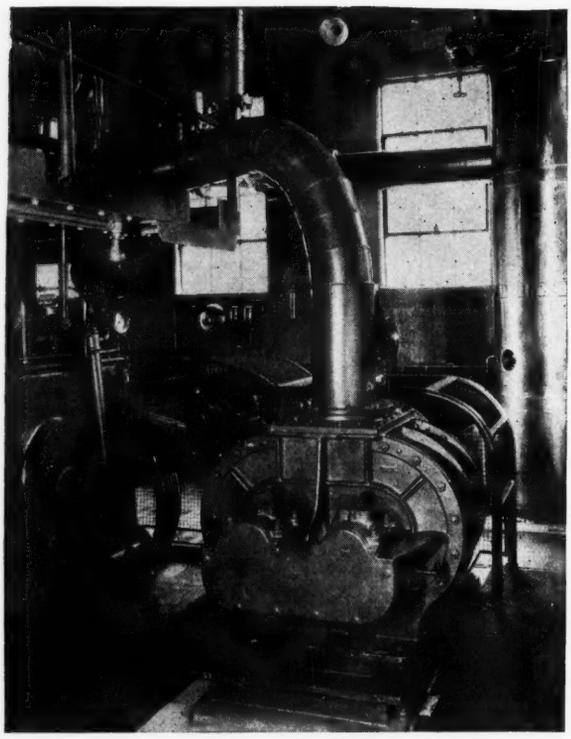
Right—Air for a New York City subway construction is supplied by Diesel compressor units

The flood-control program for the Mississippi River called for a number of drag-line excavators for levee construction. These were Diesel-powered in several different ways. In one case a Diesel was mounted on the hoist tower, which traveled on a two-rail truck. In another installation, the likelihood of engine vibration prompted the designer to place the engine with its direct-connected generator on a trailer car, to supply energy to the several hoist motors.

This type of application, that is, for contractors' mobile equipment, is one in which the Diesel made marked strides during the year. Many power shovels, drag-line excavators and rock crushers are being powered with Diesels. The shovel requires a high-speed engine of small cubical dimensions, if not of light weight; consequently a number of builders have developed, or are developing, units to operate at 600 to 1,200 r.p.m. At least two builders have attached an exhaust-heated vaporizer to permit the gasification of the heavy oil, so that the engine can handle a mixture of fuel and air and operate on the electric-ignition Otto cycle. A similar engine has been placed in busses, but the bad odor of the exhaust, due to the oil-cracking process, seems to limit this application.

In the field of aviation, the Packard Motor Company attracted world-wide attention by its demonstration of a radial single-valve solid-injection Diesel. Little can be learned concerning this unit, but it is undoubtedly not yet in the commercial stage of development. The free exhaust of the burnt gases, while probably permissible in a military plane, would prove offensive to passengers of even cabin planes. The Beardmore English engine, while too heavy for airplanes, was probably the best development of the year for "air" engine, even though limited to dirigibles.

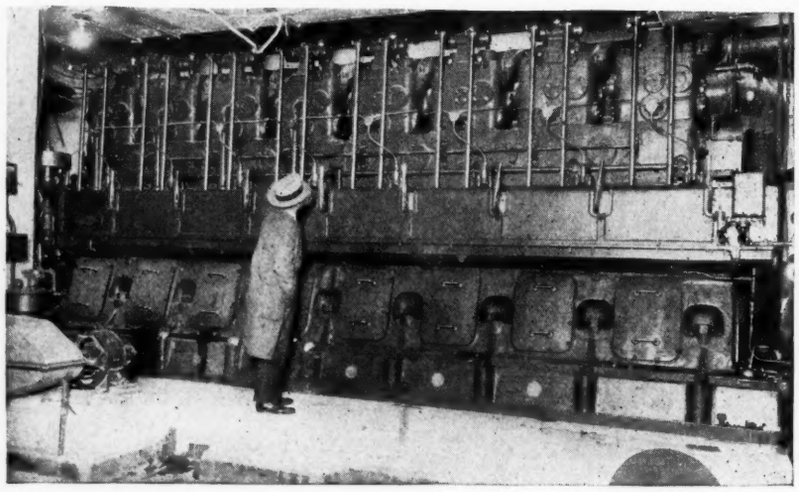
In spite of the enthusiasm of owners of existing motorships, and the hopes of engine builders, the American Diesel marine situation developed no satisfactory aspects during the year. Tugs, ferry boats and coastwise tankers are being Dieselized, but as for ocean-going motorships, America can cite few, other than those of the Shipping Board. True the Sun Shipbuilding & Dry Dock Company has contracted for a large South African Diesel liner and several Diesel tankers; yet the marine situation is not as attractive as it might be, especially to those firms that, under the urge of the Shipping Board, invested vast sums in patterns and designs. The marine engine builder is in direct competition with the European builder, for a shipping firm will not pay a differential of 25 to 50 per cent for the privilege of flying the American flag. Consequently, lately one oil firm placed contracts for four motorships with European yards.



Superchanging blower used on mechanical injection Diesel at high altitudes

New designs announced during the year include the Setz double-acting two-stroke-cycle air-injection unit built by the Sun Shipbuilding & Dry Dock Company, the Fulton Iron Works four-stroke-cycle mechanical-injection engine, and the Buckeye four-stroke-cycle mechanical-injection Diesel.

The advent of the latter two engines may be regarded as significant of the trend in Diesel design toward the mechanical—or airless-injection principle. For units below 300 hp., the airless-injection engine predominates, and between this and 1,000 hp. it has made greater inroads during the year. When preference has been



A four-stroke-cycle Diesel engine installed in the New Yorker Hotel for breakdown and heat-balance purposes

given to the air-injection engine it has been based, generally, on its ability to handle successfully a cheaper grade of fuel. As the unit capacity increases the cost of fuel assumes a greater importance, so that large Diesels are practically all of the air-injection types. Of engines sold during 1929, 116,000 hp. were air-injection, 133,000 four-stroke-cycle mechanical-injection and 183,000 were two-stroke-cycle mechanical-injection engines. The total was slightly under the sales in 1928, but this was due to a decrease in new industrial and marine construction rather than to any decrease in Diesel popularity. The pipe lines have been more or less dormant, whereas usually they absorb 20 per cent of the Diesel output.

The Diesel locomotive has proved its adaptability for switching service. During the year one company sold over forty 300-hp. switching locomotives, some arranged to operate, if necessary, by a third rail, and others provided with storage batteries to increase the engine's power for short intervals. As a main-line locomotive the Diesel has yet to find real acceptance.

While supercharging has been employed by European builders on marine engines, it is seldom that American builders venture to increase engine output in this way. Some years ago certain two-stroke-cycle engines that did not develop their sea-level rating at high altitudes were supercharged. But the first commercial application of supercharging of four-stroke-cycle engines occurred during 1929, this being a 600-hp. mechanical-injection engine installed at an altitude of 9,200 ft. for the Denver & Salt Lake Railway. Normally at this altitude the engine will develop only 70 per cent of its rating. A Root blower was belted from the engine shaft to deliver a full air charge to the cylinders. This permitted an output of 585 net brake-horsepower to be delivered by the engine, although at a decrease in engine fuel efficiency.

Various improvements have been made in engine parts, such as chrome plating of piston rods of double-acting engines, and, lately, chrome plating of piston and cylinder liners. In the manufacture of small parts, such as fuel pumps, a better grade of metal and workmanship has been observed.

In the research lines, Langley Fuel and Penn State College continued the investigations of fuel-spray formation. The American Society of Mechanical Engineers, through its special Research Committee on Diesel Fuel Oil continued its investigation during the year. Several manufacturers submitted samples of oil, and reported back the results. At present two suggested standard fuels have been established, but the test reports indicate that at least three standards must be set up.

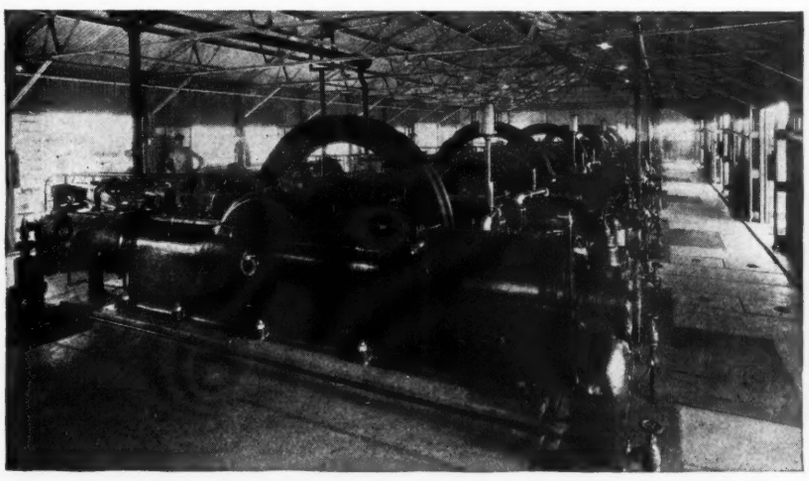
About forty 1,000-hp. double-acting tandem gas engines were installed in 1929. For industrial plants where gas is available many such engines have been installed. To guard against a shortage, some of the engines have been designed so that they can be altered to burn fuel oil by changing the piston and adding the fuel pump and other small parts.

One firm has boldly gone about making its Diesel burn gas while still operating on the Diesel, or compression-ignition, cycle. This has been accomplished by disengaging the fuel pump and piping from the spray valve. Gas is led to the injection-air compressor and after compression to 600-800 lb. is passed to the spray valve, which has been denuded of its atomizer disks. The opening of the timed needle valve permits the gas to rush into the cylinder, where it combines with the hot air and burns. Regulation is obtained by governor control of the needle-valve lift. The velocity of the gas stream is enough to prevent back flow and burning of the spray valve tip.

The oil-field gas engine has had a hard struggle in recent years, due to the electrification of some of the oil fields. This process was reversed during 1929, and gas engines were installed on motorized locations. Sales during the year were not exceptional, but this was due to the reduced number of wells brought in during the year.

For oil-field pumping the horizontal single cylinder gas engine has been preferred, although in 1927 and 1928, the multi-cylinder high-speed gas engine was applied to many oil drives. Being lower in first cost and lighter in weight, apparently it was doomed to supersede the slow-speed single-cylinder engine. Experience revealed certain characteristics that made it unsuitable for many fields, and the single-cylinder engine came to the front. This competition did force the builders to improve the latter engine to permit a speed increase—to 500 r.p.m. in one case.

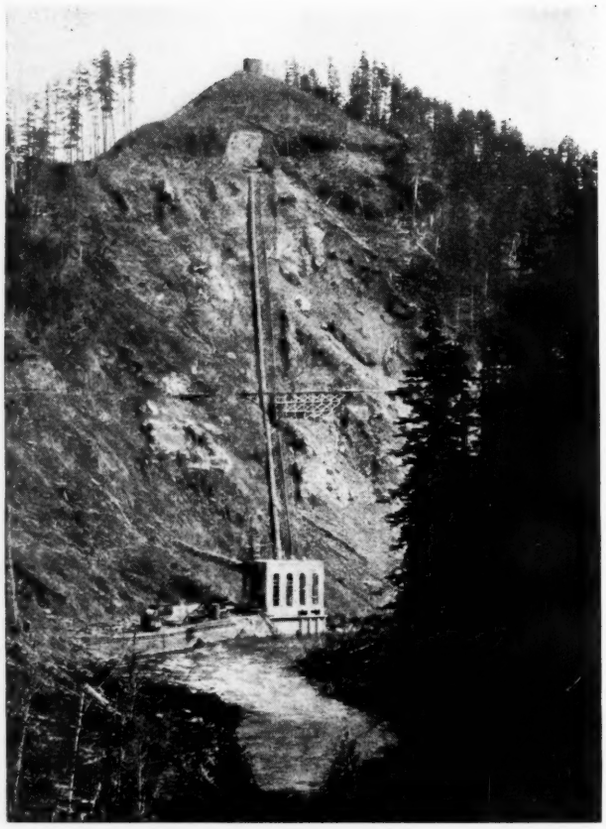
The application of the blast furnace engine is limited to steel mills, and no great horsepower output is to be expected in any one year. One firm, however, built and has delivered to the Illinois Steel Company the largest gas engine ever built, with a rated capacity of 10,000 horsepower.



A casing-head gas plant where the compressors are driven by natural-gas engines

HYDRO DEVELOPMENTS

Show Increased Activity



Portland Power & Light Company's Oak Grove plant (Oregon) has the highest head (960 ft. static) reaction turbine. A second unit of 40,000 hp. was ordered in 1929.

WATER-POWER development enters 1930 with bright prospects. At this time there are approximately 1,500,000 hp. of contracts in the shops of waterwheel builders in the United States. About 1,100,000 hp. are for installations in this country and 400,000 hp. for export, as indicated in the table. In Canada, as in the United States, the contracts for waterwheels under construction are large. Most of these wheels are built by subsidiaries of the companies in the United States or from these companies' designs and under their patents.

Both in this country and Canada work has already been started on projects that will insure large contracts for water-power plant machinery during this year. This indicates that water power is well able to compete with steam. True, all the builders of water-power equipment do not have all the business that they might like to, but this does not change the fact that hydro development in this country and Canada is in a healthy condition and has good future prospects.

In point of kilowatt-hours generated and percentage of total power produced, 1928 exceeded all previous records for hydro-electric plants. Over 40 per cent of all the power generated in central stations was produced by water power. The average for the eight years, 1920 to 1927, inclusive, was 35.6 per cent. This last year the power produced in water-power plants was approximately the same as in 1928, or, about 35 billion kilowatt-hours. On account of an increase of about 12 per cent in the power produced in central stations, water power represented less than 37 per cent of the total, as against over 40 per cent for 1928. For the first half of 1929 there was a sharp rise in the power output of hydro-electric plants over the previous year, but in the last half the output fell off sharply. Beginning in June, the 1929 kilowatt-hour curve fell below that for 1928 and remained there for the remainder of the year. The loss in kilowatt-hours in the latter half of the year about equaled the gain in the first half; consequently there was no increase over the previous year.

DURING the last few years there has been a slowing up in new water-power undertaking on the Pacific Coast. The drought of the past year will probably tend to further curtail developments temporarily. In California oil conservation laws that became effective in 1929 made available large quantities of natural gas at low cost. This, combined with cheap oil, makes it possible to produce power in steam plants at low cost and tends to retard water-power development in that state. Notwithstanding, water-power projects of considerable magnitude are now under construction on the Pacific Coast.

At the present time studies are being made of two large projects in Washington and Oregon, one on the Columbia River and another on one of its tributaries, the Deschutes. If a market can be created for the power, there are possibilities that the projects will be started in no distant future.

Boulder Dam, on the Colorado River, is still in controversy, although plans are being worked out to start work on it as soon as contracts are let for the power. At present the contracts are tied up awaiting an agreement on the distribution of the power. President Hoover

recommended to Congress that the necessary funds be appropriated for the initiation of the work as soon as contracts for the power are in the hands of Congress. Although there are reassuring indications that work will be started on the project this year, the capriciousness of politics gives cause for doubt.

Ray L. Wilbur, Secretary of the Interior, in his annual report to the President states, regarding Boulder Dam: Under the Commissioner of Reclamation, Dr. Meade, engineering plans are progressing in a satisfactory manner, with the assistance of an augmented field force. An advisory group of experts on electrical engineering and plant management is functioning and has collaborated with the bureau in determining the financial basis on which the power shall be marketed. Work on the dam will be begun as soon as adequate contracts have been negotiated and congressional appropriations made.

NO POLICY has as yet been established in New York State regarding water power. Until this is done the possibilities of developing the international section of the St. Lawrence River and further development on the Niagara River do not look promising. Governor Roosevelt has apparently decided to carry into effect the water-power policies of his predecessor for state development. The State Legislature has definitely taken an opposite attitude; therefore these projects may be political footballs for some time to come.

The subject of steam plants vs. water power was argued a-pace during the year. There is no question about the effects of cheap fuel and recent improvement in steam plant design and efficiency having changed the economic relation between these and hydro-electric plants in a way as to make it more difficult for many water-power developments to compete with steam. Nevertheless, there is developing a general appreciation that the load curve of large power systems can be more economically supplied by a suitable combination of hydro and steam plants than by steam plants alone. In other words, these two sources of power are complimentary rather than competitive. They both have a place in the power picture.

One of the best proofs of the foregoing statement is that in the most extensive coal region in this country some of the largest hydro developments are being made. Last year the Conowingo plant, of 378,000-hp. capacity, on the Susquehanna River near Baltimore, Md., went into operation. This year at Safe Harbor, Pa., on the same river preliminary construction was started on a development that will have an initial capacity of 230,000 hp. In the spring of 1930 construction of the dam and power house is to be started. Above Safe Harbor, at York Haven, an old development is being rebuilt and enlarged. All this is taking place almost at the mouth of coal mines; in fact, at least part of the fuel for steam plants can be had for the cost of pumping it from the rivers' bottoms.

In Canada water-power development is going ahead at a rapid rate. Some of the largest projects in the world are being constructed. Notable among these is that of the Beauharnois Power Corporation on the St. Lawrence River. This development when completed will have a capacity of 2,000,000 hp. The initial plans are for 500,000 hp. in ten 50,000-hp. units to operate under an 80-ft. head, which is the fall between Lakes St. Francis and St. Louis. The plant of the Alcoa Power Company, on the Saguenay River, will ultimately have 1,000,000 hp. capacity. Four 65,000-hp. units are being installed.

The Montreal Island Power Company put into operation its plant on Back River near Montreal during the year. This plant has six 12,000-hp. units installed and is laid out for 10 ultimately. The runners are of the adjustable-blade propeller type. Since the head is only 26 ft., the runners are of very large diameter. At Seven Sisters Falls on the Winnipeg River the North Western Power Company has started work on a 225,000-hp. plant. The initial installation is three 37,500-hp. 66-ft. head units of the fixed-blade propeller type. Work has been started on the Chats Falls development on the Ottawa River, a project of 250,000-hp. The Bridge River development of the British Columbia Electric Railway, Ltd., is progressing. This project when completed will have an ultimate capacity of about 600,000 horsepower.

These projects and others not mentioned are indicative of the progress being made in water-power development in Canada. Such rapid development might well raise the question as to how fast the power is being absorbed. What is happening in Ontario is probably the best answer to how power consumption is keeping ahead of the supply. The Ontario Hydro-Electric Power Commission has a contract with the Gatineau Power Company that calls for the delivery of 260,000 hp. by Oct. 1, 1931. The commission is now 20,000 hp. ahead of its contract. The Beauharnois Power Corporation has let contracts for 400,000 hp. from its development on the St. Lawrence River, which has only recently been started. Such conditions indicate a healthy gain for water power in Canada.

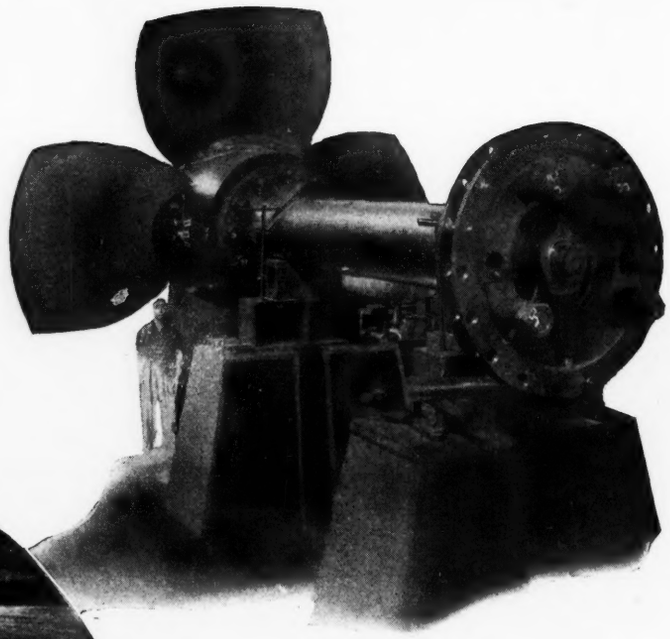
THE most marked development in water-power equipment is in the applications of propeller-type turbines. To improve the part-gate efficiency of this type of runner, the blades are made adjustable. A type with manual adjustment of the blades has come into quite extensive use. An outstanding installation of this kind are the six 12,000-hp. 26-ft. units in the Back River plant of the Montreal Island Power Corporation, previously referred to. The contracts for these wheels went to two companies in Canada. During the last three or four years several such installations have been made in the United States.

Propeller-type runners that have the pitch of their blades adjusted automatically from the governor are also being built. An installation of this kind was made at Devils River plant No. 9 of the Central Power & Light Co. in Texas. This unit is rated at 1,900 hp. under a 33-ft. head at 300 r.p.m. Orders for other units of this type have been placed in the United States and Canada.

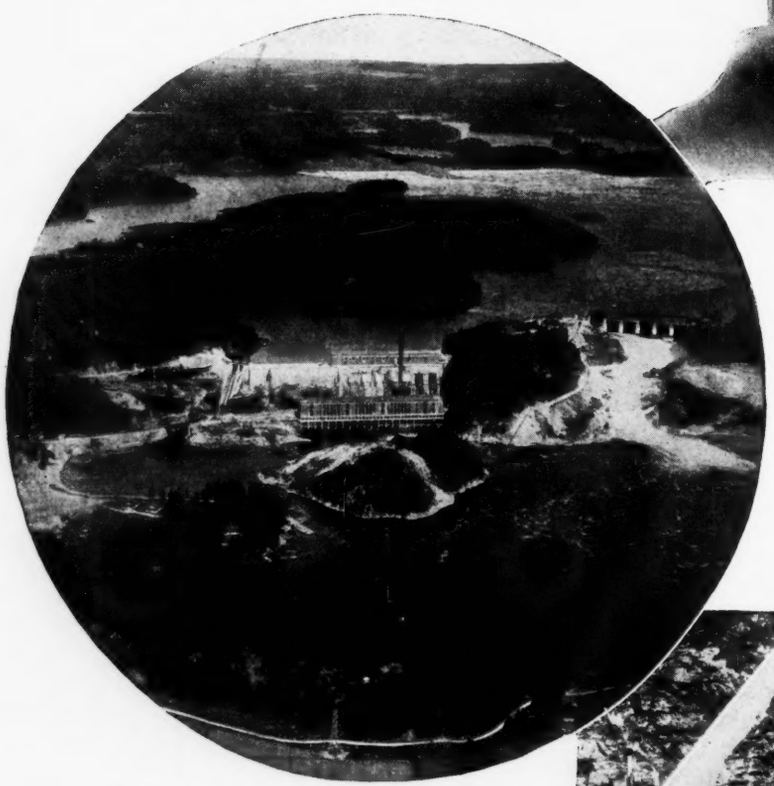
PRINCIPAL WATER-POWER EQUIPMENT BEING CONSTRUCTED IN THE UNITED STATES

Company	Project	No. of Units on Order	Size, Hp.	Effective Head, Ft.	Type
Union Elec. Lt. & Pwr.	Osage River	6	33,500	90	Francis
Union Elec. Lt. & Pwr.	Osage River	2	1,600	90	Francis
Central Maine Pwr. Co.	Wyman	2	34,000	135	Francis
N. E. Power Association	15-Mile Falls	4	53,100	175	Francis
Lexington W.-P. Co.	Saluda	4	55,650	180	Francis
Arkansas Pwr. & Lt. Co.	Carpenter	2	37,000	115	Francis
Portland Pwr. & Lt. Co.	Oak Grove	1	40,000	930	Francis
Pacific Gas & Elec. Co.	Tiger Creek	2	36,000	1,190	Pelton
Pacific Gas & Elec. Co.	Salt Springs	1	13,500	244	Francis
City of Tacoma	Lake Cushman No. 2	2	37,500	440	Francis
City of Seattle	Kagit River	1	26,500	275	Francis
Western Washington Elec. Lt. & Pwr. Co.	North River	2	12,500	....	.....
N. Y. Power Corp.	Spier Falls	1	57,000	81	Francis
Alabama Pwr. Co.	Upper Tallassee	2	24,000	....	.....
Foreign Contracts Country					
Russia	Dneiper River	4	84,000	116.5	Francis
Mexico	.....	1	14,000	78	Francis
Brazil	Parahyba	1	40,000	104	Francis

Right — Propeller-type runner rated at 12,000 hp. and 26-ft. head has its blades adjusted by hand to maintain high efficiency. Six of these units are installed in the Back River plant of the Montreal Island Power Company, Canada

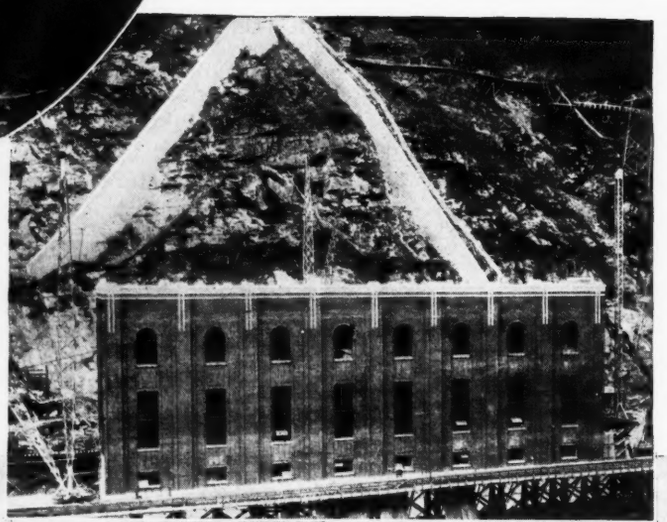


Below—Paugan plant of the Gatineau Power Company, Quebec, is designed for eight 34,000-hp. units, of which six have been installed

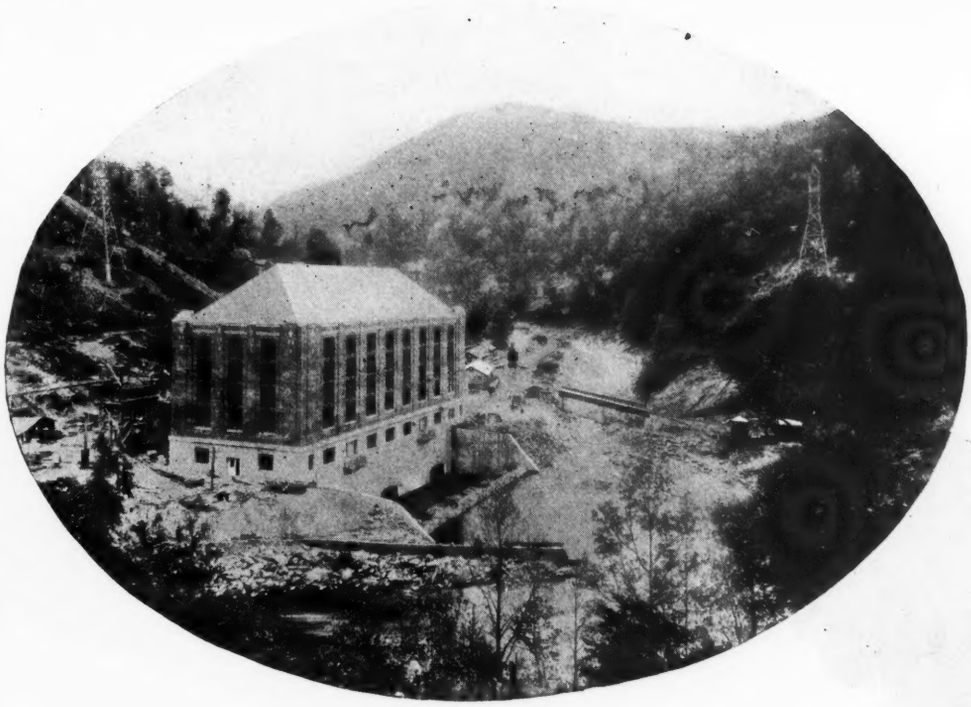


Recent HYDRO *as Seen*

Right — Calderwood plant of the Knoxville Power Company, Tenn., has three 56,000-hp. 213-ft. head units



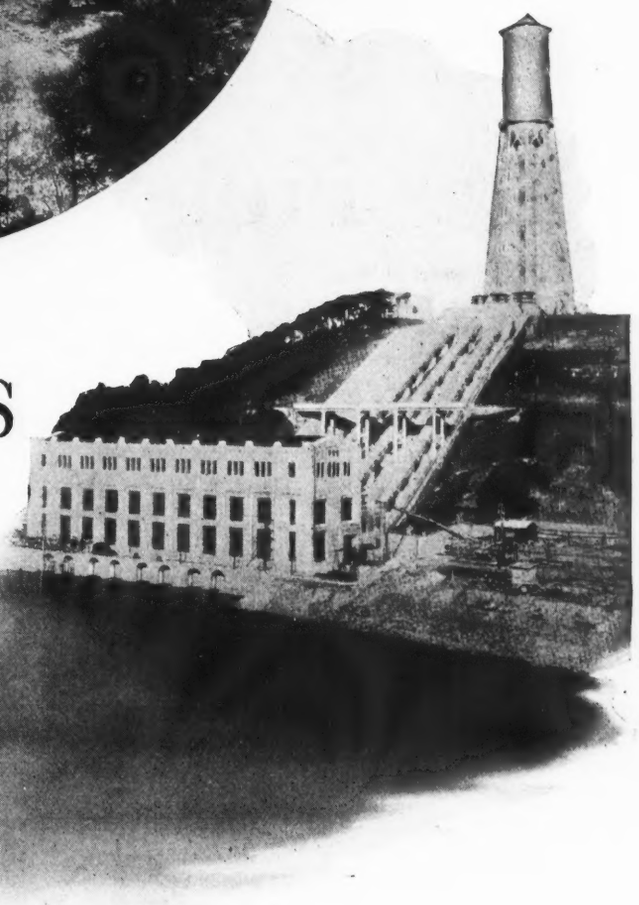
Below—Back River plant, Montreal Island Power Company, designed for ten 12,000 hp. 26-ft. head units with adjustable-blade propeller runners



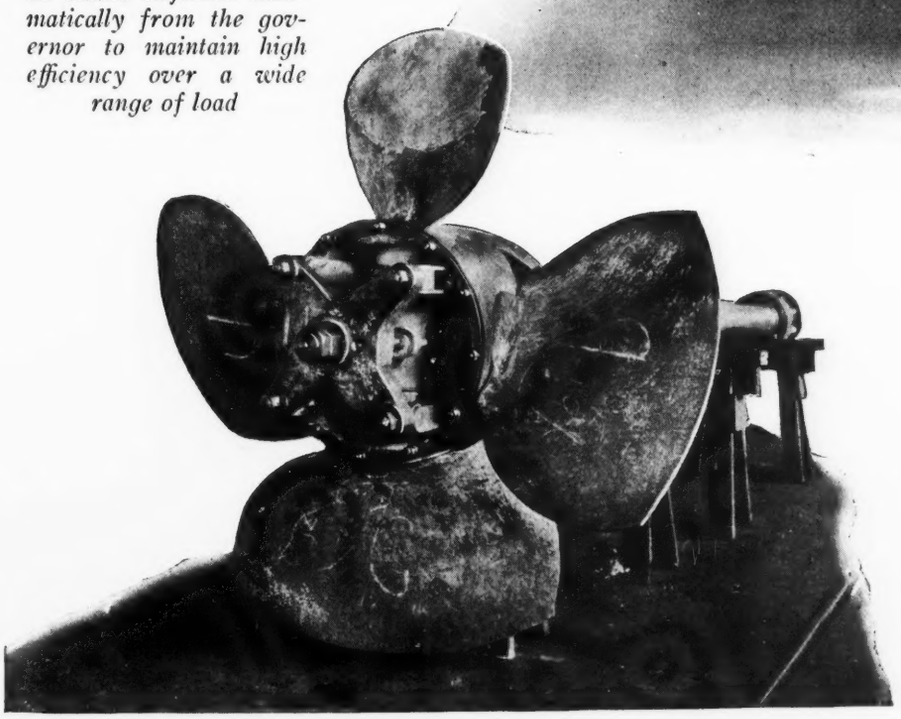
Left — Waterville plant of the Carolina Power Company has three Francis turbines of an aggregate capacity of 100,000-kw. operating under a static head of 860 ft., the highest east of the Rocky Mountains

DEVELOPMENTS

by the Camera

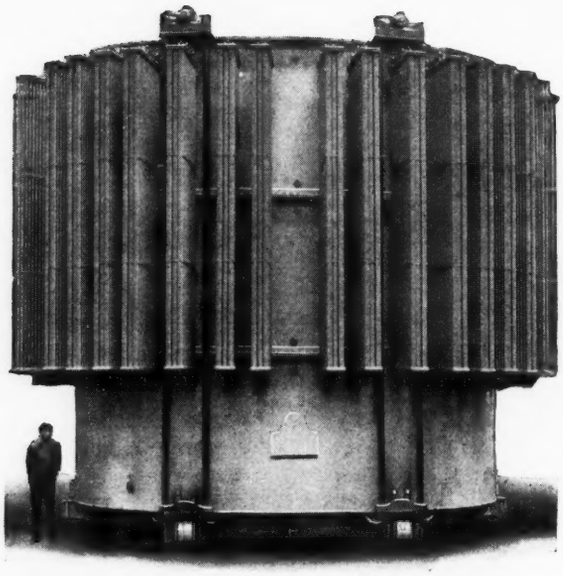


Below — Propeller-type turbine runner that has its blades adjusted automatically from the governor to maintain high efficiency over a wide range of load



Above—The Saku plant of the Kanto Hydro-Electric Power Company in Japan is designed to be earthquake-proof. The plant has three 36,000-hp. units, operating under a 390-ft. maximum head. All the hydraulic and electrical equipment in the power house was built in the United States

Large Units *Feature* Electrical Progress



A 30,000-kva. self-cooled transformer for the Public Service Production Company of New Jersey

EACH YEAR sees many new developments in the electrical industry, but these are generally overshadowed by the phenomenal growth of the industry itself and the size of the units installed. The year 1929 was no exception; central station kilowatt-hours generated reached the unprecedented value of about 97 billions. This was an increase of about 12 per cent over last year's figures of 87 billion kilowatt-hours.

A number of record-breaking machines were put into operation, among them the 200,000-kw. unit in the State Line Generating Company's station near Chicago. This installation consists of three generators, two rated at 62,000 kw. and one 76,000 kw. at 22,000 volts, making it the largest cross-compound unit so far built. The usual switching and busbar arrangement used in most power plants was omitted in the State Line plant. Instead, the generator busbars, switching equipment and step-up transformers are installed outdoors. The busbars are inclosed in oil-filled bronze pipe and the connections are made in oil-filled bronze junction boxes, each phase being isolated, and all circuits are metal clad. A three-section double-ring bus is used with one generator connected to each section, and metal-clad oil-immersed reactors and oil circuit breakers are inserted between sections.

The largest single generator was put into operation the latter part of the year. This machine is rated at 160,000 kw., 11,400 volts, 1,500 r.p.m., and was installed in the Fourteenth Street station of the New York Edison Company. One of its unusual features is the use of two independent windings in the stator. Since the output of the machines is about 8,000 amp., it is considerably in excess of the capacity of a single switch. Also connecting several of such generators on a bus with any of the customary arrangements of protective reactors could result in large short-circuit currents. The solution of these problems was found in putting two electrically independent windings in the stator and correcting each winding to a separate bus. By this arrangement the switches have to carry only about 4,000 amp., well within the limits of the station equipment. A 75,000-kw., 13,800-volt, 1,800-r.p.m., double-winding generator was put into operation in the Cahokia Station of the Union Electric Light & Power Company at St. Louis.

The use of double windings, improved methods of measuring temperatures, better systems of ventilation, new insulations and methods of applying them, the use of welded structures, and other improvements in design, have pushed the limit in size back to where it now appears possible to construct a single generator of about 240,000-kva. capacity.

A 115,000-kw. generator for the Waukegan plant of the Public Service Company of Northern Illinois is the largest single-winding machine so far constructed. This machine is designed for 18,000-volt 60-cycle operation and will run at 1,800 revolutions per minute.

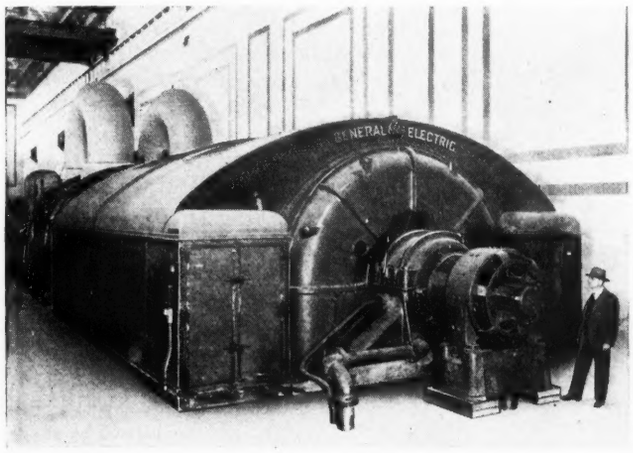
A new type of high-speed blower for ventilating large generators was announced during the year. Three of these blowers, driven by 300-hp. 3,250-r.p.m. induction motors, are used on the 165,000-kw. double-generator unit in the Hell Gate station of the United Electric Light & Power Company, New York City. These blowers and their motors are mounted vertically below the generators, and discharge into a common air chamber between the two machines. The shop test on the blowers alone showed a static efficiency of 76 per cent and a total overall efficiency, including the effects of the air velocity at the exit of 81 per cent.

Hydrogen cooling of electric generators continued to attract attention. Although no generators with this type of cooling have been reported in operation, it was announced during the year that there were possibilities of several machines with such a system being put into service in the near future. The largest of these will have a 30,000-kva. rating. As announced last year, there are now two large synchronous condensers in operation using hydrogen as a cooling medium. The principal advantage of hydrogen cooling is that it allows increasing the machine's capacity about 25 per cent over the rating obtained with air cooling.

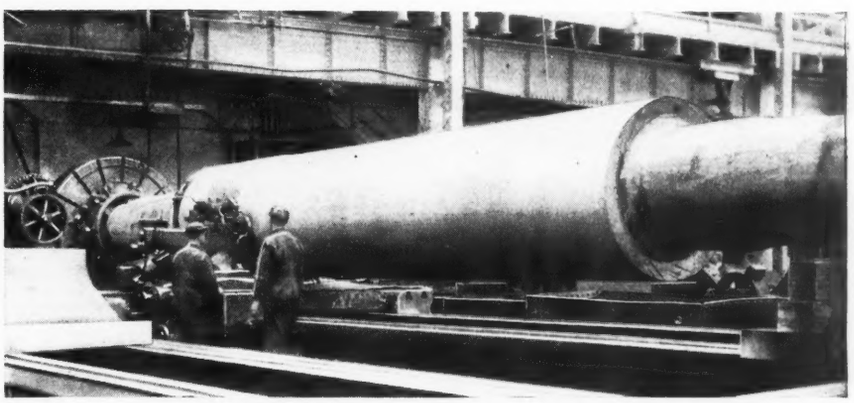
The cooling of generators with carbon dioxide has been proposed. The coolers are to be placed in the

ventilating ducts of the machine in such a way that in case of a short circuit in the generator the carbon dioxide would be released to extinguish the fire. Thus, the CO_2 would serve the dual purpose of cooling the generator during normal operation and acting as a fire extinguisher in case of a winding failure.

Some of the recent machines that have gone into operation or under construction would indicate a tendency toward higher generator voltages. In this country generators are in operation at voltages up to 22,000. In Europe a 33,000-volt generator has been built. Near the end of the year one electrical manufacturer announced that it was ready to build generators for 36,000 volts. It is not generally agreed that generator voltages above the conventional 13,000 or 14,000 are the best solution to transmitting large generator outputs to the bus structure. The use of auto-transformers to step up the generator's voltage is favored by some engineers in preference to high-voltage generators. It is agreed that high-voltage generators can scarcely be expected to have the same degree of reliability as lower-voltage machines with auto-transformers.



Above—Double-winding turbine-generator, rated at 160,000 kw., in the 14th St. station of the New York Edison Company



Right—Rotor-core forging being machined for the 115,000-kw. single-winding 18,000-volt turbine-generator to be installed in Waukegan station near Chicago. This machine is the largest single-winding generator built up to this time

Russia holds the record for size in water-wheel generators, with four 77,500-kva. units that are being constructed in this country. These machines are of the vertical-shaft type and are about 40-ft. in diameter. A completely inclosed recirculating ventilation system will be used, with surface-type air coolers. Among the large water-wheel generators for installation in the United States, the four 40,625-kva. units for the Saluda plant of the Lexington Water Power Company in South Carolina are of unusual design. These machines are of the umbrella type and have a combination thrust and guide bearing located below the rotor on the lower bearing bracket. These bearings operate in a bath of oil, require no oil piping and eliminate the heavy upper bracket for carrying the weight of the rotating part. Two 31,111-kva. generators, also of the umbrella type, are being built for the Arkansas Power & Light Company.

A spherical-type Kingsbury thrust bearing for hydro-electric units was announced during the year. It is intended to act as a combination thrust and steady bearing. One of its advantages is the rigidity with which the axis of the shaft is held in one position. The bearing can be made of the concave runner type for use just above the water-wheel, or of the convex runner type for installation below the generator rotor.

Last year the first installation of an air-cooled synchronous condenser was made, arranged with housings to permit outdoor operation. The machine is rated at 15,000 kva., 11,500 volts. Air is taken through filters from the outside and discharged through the base of the machine. Coolers through which the bearing oil is circulated are in the incoming air streams. This arrangement avoids water-cooling coils, which might be a hazard in cold weather. Sufficient air may be recirculated within the machine's housing to maintain a proper operating temperature in cold weather.

Two 3,000-kw. synchronous converters designed to be cooled with hydrogen were put into commercial service. These machines will not have explosion-proof housing, such as used on synchronous condensers employing this type of cooling. These are the first large commutator-type machines with hydrogen cooling put into operation, and indicate that the manufacturer and the user believe the hydrogen explosion hazard has been overcome.

The use of load-ratio control of transformer has been greatly extended during the last year. This equipment was first developed for large units; as the advantages of being able to adjust the voltage of transformers under load has become better appreciated, the practice has been extended to units of 500-kva. capacity. The oil air-pressure system of cooling transformers is coming into wide use on large-size units. Transformers rated at 40,000 kva. and 220,000 volts, with this type of cooling, are under construction in this country, and in England 60,000-kva. units are being built.

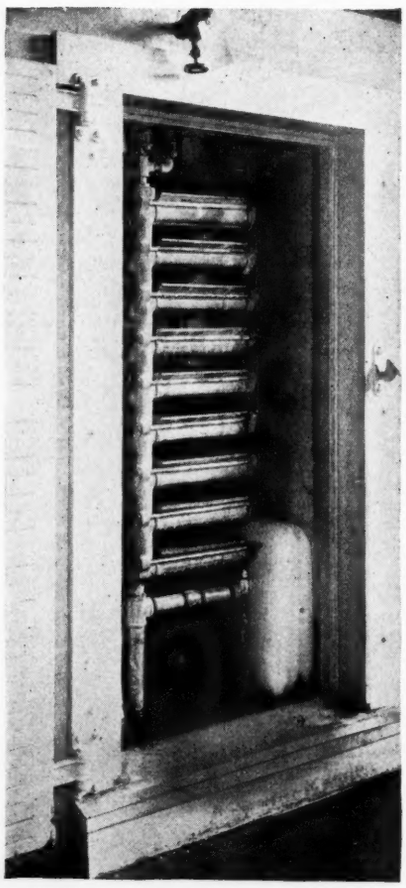
In switching equipment the most radical develpoment has been the Deion circuit breaker. Instead of breaking the arc under oil, as in the conventional type of high-voltage breaker, it is blown into a deionizing chamber and interrupted in air. A number of these breakers are in service operating on 15,000-volt circuits. Recently an installation was made that is designed to rupture 25,000 amp. at 25,000 volts.

Advancements in

Refrigerating Engineering

Reflect New Attitude

Industrial application to the fore—Silica gel gains definite position—Carbon dioxide a lively competitor of ammonia—High speed has its advocates—"Dry ice" now beyond the experimental stage



The Warner quick-freeze system, in which ice is frozen in shallow pans by direct expansion

IN 1929 refrigerating engineers and machinery builders became "industrial-conscious" and abandoned the idea held for so long that ice making only was the future of the refrigerating art. This new attitude was reflected even in the character of the papers presented before the refrigerating engineer societies' meetings, where the greatest interest was displayed in the problems of food freezing and handling, theater and hotel air conditioning, railroad car refrigeration and new refrigerating processes. In fact, the principal papers at the winter meeting of the A.S.R.E. were devoted, in the main, to discussion of this new trend of the industry.

The most spectacular application of refrigeration in recent years has been that of air conditioning. While the first to take up this artificial cooling of air were the theaters (when it became the predominating influence in the gathering of audience), during the year this refrigerating application was extended to hotels and office buildings and, in an experimental way, to the home. At present there is but one known home application, which consists essentially of a gas heater with a humidity control, to which is attached a gas-fired absorption refrigerating unit, so that in the summer cold air is circulated through the same ducts that carry warm air in winter. This is an application that will undoubtedly find a general adoption for large residences in the South.

Refrigeration as applied to air conditioning in industrial works received increased attention during the year. Many installations are being made where variable temperatures would effect the quality of the product, as in rayon mills, printing shops and slate-shingle mills.

In the several new rayon mills erected during 1929, many strictly refrigerating units were installed to control the chemical processes in the viscose manufacturing. Among these was the Covington, Va., plant of the Industrial Rayon Corporation, where three 100-ton horizontal ammonia compressors were installed.

For a long time ammonia was regarded as the only commercial refrigerant. In the last few years, and especially during 1929, the advantages offered by various other media have been recognized and machines using them installed. This applies particularly to CO_2, which has gained a dominant position in public buildings. So marked are its advantages of being non-toxic and odorless that practically all builders of ammonia compressors have brought out a line of carbon-dioxide machines. The designs have been both horizontal and vertical; the latter has been the more generally adopted, on account of its inclosed frame, which is almost necessary where inexperienced attendants care for the equipment. A notable CO_2 installation made during 1929 was in the New Yorker Hotel, where the machines are used both for cold storage and for air conditioning.

Many CO_2 compressors have been installed to operate on the Vorhees multi-effect principle. In the vertical

machines this is obtained by a combination of trunk piston carrying the low-pressure suction valve and a cylinder wall port to admit the high-pressure suction, or "flash" gas.

The problem of leaky joints has been avoided by welding. In some plants installed during 1929, no joints exist in the entire system, with the exception of valve stem glands.

The more general use of multi-effect was also registered in the case of ammonia compressor plants. The advantages of this principle, long disputed by engineers and machine builders, have at last received general recognition, unfortunately, however, after the Vorhees patents have expired.

While multi-effect operation shows some savings in an ice-freezing plant, it is more desirable in cold-storage and process systems where two temperatures are carried. It is then possible to interconnect the "flash-gas" receiver, or precooler, with the higher suction, and the machine can be better balanced than in the case of the ice-plant compressor using two suctions.

In one case a two-cylinder compressor has been connected up so that the two ends of a cylinder handle suction gas at different pressures. There is every reason to expect that most new plants in the future will use the two-suction, a multi-effect principle. While the system has been slow of adoption with CO_2, many such machines are being installed.

A general trend toward higher compressor speeds has been noticed during the year. This has been occasioned both by the desirability of direct connection to electrical motors and by a need for machine manufacturing economies. Instead of building one or two compressors to meet a plant's particular load requirements, the compressor builder has adopted the plan of selling from two to ten small machines of the same aggregate capacity. This means that compressors can be built by modern production methods. In addition, the plant owner obtains a degree of capacity control impossible in a plant holding but one or two large compressors.

There is a distinct trend to compressors of three and four cylinders. There are many reasons to believe that in the future the refrigerating compressor will be similar in appearance to the six-cylinder gasoline engine, arranged for direct connection to 1,800-r.p.m. motors.

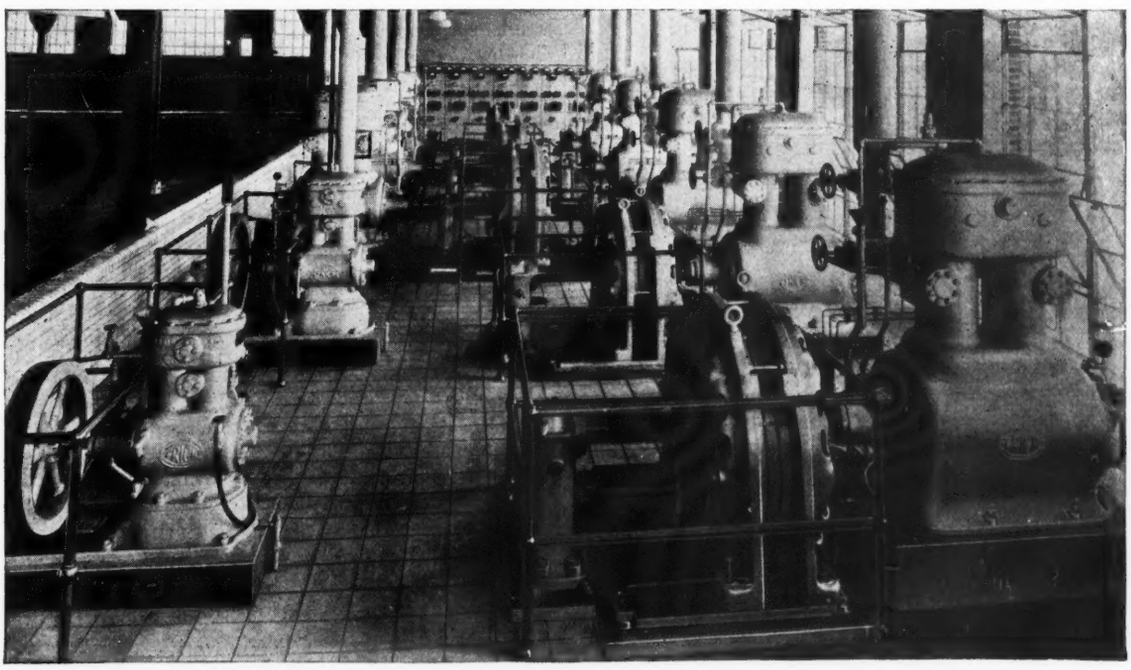
An ice cake of standard dimension is probably necessary for commercial sale, but when the ice is crushed any shape is permissible. By the use of shallow pans the freezing time can be reduced, to the accompaniment of lowered investment costs. In the Warner freezing system brought out commercially during the year, shallow cast-iron pans are provided, with cored passages through which the ammonia flows. Freezing time is reduced by 50 per cent, and the elimination of brine as an intermediary lessens the temperature differential and so raises the suction pressure. The plates of ice, about two inches thick, can be crushed for packing purposes.

This system has been adopted to freeze brine for ice cream packing. The lower melting temperature of the brine ice keeps the food solid, and there is no loss in salt settling, which occurs with the usual crushed-ice-and-salt mixture.

Dry ice, or CO_2 snow, has obtained a commercial footing, and is past the experimental stage. The dehydration of vegetables and fruits occurring when CO_2 is used has led to the development of a new dry ice, in which about 8 per cent of water is mixed with the CO_2 during freezing. The moisture released during melting eliminates dehydration. It is especially desirable when fish is being handled.

Much attention has been given to railway refrigeration. A compression type of car refrigerating system has been developed in which the compressor is driven from a car axle. The silica gel system has been improved in mechanical arrangement, and a number of railroad cars so equipped have been put into regular service.

While the advent of the household ice machine was looked upon as spelling the doom of the large commercial machine, no such thing has occurred. The ice business lost has been offset by greater industrial applications.



This plant, with 10 high-speed small compressors rather than the one or two slow machines formerly used, is a good example of the modern trend

Better Control Methods Mark Progress in

Heating and Ventilating

THE present trend in the field of building heating is toward a more general recognition of ideas and methods of heating-system control that were advanced several years ago. The availability of new equipment designed for this purpose has greatly aided this progress.

New equipment has also lowered both the operating and investment costs; while design data obtained from various researches, and made available to the industry, has resulted in better proportioning of heating systems.

There are two main types of control, in one a room thermostat regulates the steam flow to the radiators in the room, and in the other steam flow to all radiators is controlled from a central point.

While there has been progress in both types, the greater advance seems to have been in the latter, which uses the orifice to secure uniform distribution, together with various means for controlling the steam temperature or its flow to the radiators. There are four such systems, two of which were made available early in the year.

The use of the orifice in the radiator inlet and in the distribution piping to secure uniform heating of radiators and to permit zoning has attracted considerable attention. An outstanding installation is that in the United Shoe Machinery Corporation Building in Boston. The heating system of this building is divided into eleven zones. Equipment installed permits separate control of the steam flow to each zone from a single control panel. By controlling the steam flow only that portion of each radiator necessary to produce comfort is heated.

Another recent development in control equipment is the radiator inlet valve, in which a thermostatic element has been incorporated. When the room reaches the desired temperature the thermostatic element is designed to shut the valve and thus stop the steam flow to the radiator. Although a valve of this type has been built for several years, it was not until last year that other manufacturers took up the idea. Several large installations, such as in the Fisher Building, Detroit, have been made.

During the past year there has been a trend toward the greater use of the copper fin or extended-surface-type radiator. These radiators are generally used with inclosures, and because of their small dimensions for a given heating effect they can be recessed and therefore take up less floor space. Less weight and smaller size also makes them easier to handle and to install.

Unit heaters have continued to find favor for industrial type buildings, and in a few cases have been installed in stores and offices. There has been no radical change in the design of these units.

Several heating systems have been designed to use electric energy. To make these economically possible, the electric energy is used only during the night or off-peak period, at which time lower rates can be secured from the utilities. The heat developed by the electric energy is stored in a large volume of water which is circulated through the radiators and heats the building in the daytime.

Several new central heating plants were placed in operation or are under construction. The Twelfth Street plant of the Allegheny Steam Heating Company, Pittsburgh, was placed in operation early last year. It contains two 36,700-sq.ft. stoker-fired boilers that can deliver about 600,000 lb. of steam per hour at 250-lb. pressure to the steam distribution system of downtown Pittsburgh. Space has been provided for four additional boilers, which, when installed, will bring the ultimate plant capacity to 1,800,000 pounds per hour. Work on a new heating plant in Boston has been started by the Edison Electric Illuminating Company of Boston. The boilers will be fired with pulverized coal.

Welding is being used extensively in the fabrication of central heating distribution systems and in the heating systems of large and small buildings. Reduced piping resistance has been brought about by a method of torch-bending the pipe into shape on the job as the heating system is fabricated and by joining the run-out pipe supplying a radiator to its riser by welding an easy lateral branch. In such bends and connections the resistance to flow is little more than the resistance of the corresponding straight pipe before bending.

THERE has been a continued increase in the demand for air conditioning to maintain comfort the year round and to control various manufacturing processes. Installations in the national Capitol Building, R. H. Macy's department store and the New Yorker Hotel are a few of the outstanding air-conditioning systems. Air conditioning has been provided in such plants as the Industrial Rayon Company's new plant at Covington, American Enka Corporation's plant at Asheville, North Carolina, and the Westinghouse Lamp Works, Bloomfield, New Jersey.

Although not yet generally available, there has been developed a small air-conditioning unit embodying refrigeration and dehumidification for installation in offices, residences and other small spaces. This development clearly indicates the trend and extent of activity in this field.

The American Society of Heating and Ventilating Engineers is actively sponsoring fifteen research projects. Five of these projects are being carried on by the society at the United States Bureau of Mines, Pittsburgh, Pa., while the other researches are in progress in various university laboratories with which the society has co-operative arrangements.

Of major import among these projects are the work done on the heat- and air-volume output of unit heaters, which has resulted in the preparation of a test code; the study of pipe sizes for hot-water heating systems; the study of garage ventilation; and a co-operative determination with the United States Weather Bureau of the atmospheric condition in thirteen cities in regard to the amount of dust and soot carried in the air.

Improvements in Power Plant Materials in 1929

THE past year has shown no outstanding developments in the field of refractories. The trend noticed in 1928 toward more general adoption of the mullite type of refractory has continued. This has been more noticeable in the products depending for their mullite on a natural source, which are finding continually wider acceptance in plants demanding a high grade of refractories to withstand severe service. The synthetic mullite refractory, while its use is rapidly extending in the ceramic and chemical fields, is not yet employed to any extent in steam boiler furnaces.

In spite of the wide adoption of various types of water-cooled furnace walls, there appears to be no particular restriction of the use of refractories. While a water-cooled wall is generally preferred for pulverized-coal installations, the refractory is widely used in oil- and gas-fired boiler furnaces, and it is at least holding its share in the stoker-fired field.

In fireclay refractories the trend is toward the more careful selection of raw material and more careful fabrication, resulting in a product that develops a typical mullite crystalline structure in use, and gives results in the furnace comparable to the high-grade refractories of mullite content.

The use of high alumina and diaspore refractories continues to grow. Apparently these materials are giving good results in service.

Metals of Construction

The most notable development in the metal field during the past year has been the introduction of several steels for use in boiler construction, typified by that employed on the new steamship Bremen, which is called "Izett." These are specially heat-treated steels alloyed with small quantities of aluminum and other material, and having the quality of maintaining their ductility under conditions of continuous reversal of stress. While it is too early to state that these new materials mark a distinct advance, they are exciting much interest, and apparently indicate a trend which may result in improved materials for boiler construction.

The materials for turbine construction, particularly those used in blading, are still the subject of much research. At present the chrome-nickel steels and the stainless steels seem to be the choice of most manufacturers, but it is still hoped that a metal of outstanding qualities, with a price not too far removed from that of ordinary carbon steel, may be found. This end, however, is difficult of attainment, in view of the fact that the conditions of service continually change, growing much more severe as each year passes. Metals that were eminently satisfactory when turbine temperatures were below 700 deg. F. and pressures were of the order of 400 to 450 lb. apparently do not give as good results under conditions of 1,200-lb. pressure and 750 to 800 deg. temperature. However, the materials available at the present time give fair working results.

One new development in metals, which promises much for power plant equipment, is that typified by such materials as "Nitralloy" and "Nirosta." These materials, which are ordinary steels treated on their surface with nitrogen to form an iron nitride, are particularly resistant to corrosion and wear. "Nirosta" may be fabricated with as much ease as the original material. These qualities make them suitable for use in valves, fittings, duct work, and similar structures.

Welding During 1929

Notable progress in welding was made during 1929 both in research results and practical applications. New non-destructive tests were made public. The rules for welded pressure vessels were liberalized and further steps were taken in establishing a degree of control that will make general boiler welding safe and practicable, so that the A.S.M.E. Boiler Code Committee may feel free to remove many of its present restrictions. The use of welding for the fabrication of industrial piping, pressure vessels and machine parts has expanded rapidly. Notable applications of the year included small turbine casings and the first large all-welded surface condenser for use on land.

* * *

Progress in Low-Temperature Carbonization

INTEREST in the combination of a coal pre-treatment method, such as low-temperature carbonization, with the generation of electricity has continued at a high level. In spite of this interest there is, however, no noteworthy progress to be recorded for the year in the United States.

The "Carbocite" installation at Philo Station of the American Gas & Electric Company is not operating at the present time, although it was in use early last year. This plant has been successful as a carbonization unit, but to date no remarkable results have been obtained from its combination with a boiler plant. At present, proposals to operate a plant employing this process near the mine mouth are being investigated, and the future holds promise of success.

The McEwen-Runge unit at the Lakeside Station in Milwaukee is closed down for changes in design. This project has not proved to be a commercial success, although it has produced a satisfactory boiler fuel. The difficulty lies in the low grade of the gas produced, which has not, so far, provided an adequate financial return. Contemplated changes look to the production of a higher heat value gas, one that can be sold at sufficient profit to carry the process commercially.

The New Brunswick plant employing the K.S.G. process went into operation during the year. Some operating difficulties were encountered, but progress toward their elimination is reported. Some improvement in the quality of the coke has been made, while the gas and liquid byproducts find a ready market.

There are no other developments in the United States worthy of note at the present time, although a number of experiments now under way may be worked out to successful completion before another year has passed.

In Europe there is but one development that calls for comment: The installation of the Babcock process at the Dunston-on-Tyne plant of the Newcastle-on-Tyne Electric Supply Company. This plant makes use of the two-stage process controlled by Babcock & Wilcox, Ltd. Two retorts of 30 tons daily capacity are installed. Semi-coke from these retorts is successfully used both as stoker fuel and for pulverized fuel burners. The gas is also used as a boiler fuel. The liquid byproducts are recovered and produce a value, per ton of coal carbonized, of 57 per cent of the cost of the raw fuel. Based on the success of this plant a new installation, with a 60-ton retort, is now being made.

Steam Plant Practice in EUROPE

IN PAST reports dealing with steam power plant development in Great Britain and the Continent attention has centered in high-pressure and high-temperature installations. Quite a number of plants have been installed for operating pressures ranging from 500 to 3,200 lb. and for steam temperatures from 750 to 900 deg. Most of these high-pressure installations have been in industrial plants and for the most part the units have been small.

As typical examples: two Benson boilers at the Siemens-Schuckert Works, Berlin, generate steam at 3,200 lb., which is reduced to 2,400 lb. and then heated to 840 deg. F. for delivery to a compound turbine. In a Stockholm factory an Atmos boiler generates steam at 1,500 lb. and 760 deg. At the Witkowitz Coal Mining Company in Czechoslovakia the boilers are reported to furnish steam to a turbine at 1,700 lb. and 900 deg. F., and in the plant of the Vienna Locomotive Manufacturing Company in Austria a Loeffler boiler supplies steam to an engine at 1,500 lb. and 800 to 900 deg. Sulzer Brothers, at their works in Winterthur, have a boiler of 8,000 lb. per hour capacity operating at 1,500-lb. pressure. A small Hartmann boiler at Ludwigshafen, Germany, operates at slightly over 1,100 lb., and there are several Schmidt boilers in Germany supplying steam around 880 lb. and 800 deg. F. A plant under construction in Billingham, England, for the Synthetic Ammonia & Nitrates, Ltd., is unusual for the size of unit employed. It will contain six boilers capable of generating 270,000 lb. of steam per hour at 750 pounds and 850 degrees.

HIGH PRESSURES in central stations are not so evident, as the more recent of the larger plants, particularly in England, are being designed for pressures in the vicinity of 400 lb. The general trend, so far as turbines are concerned, rather favors higher temperatures, as turbine wheels generally are small and the material stresses less on this account. Central stations for the most part operate on low load factors, and the percentage of reserve capacity is unusually high, which does not justify high first cost, particularly where the outlay of capital must be carefully guarded. Investment costs are lower than in this country, and when coupled with economical building construction, the resulting station cost per unit approximates only 60 per cent of the American figure.

The highest pressure reported for utilities is that used in an addition to the Valley Road Station at Bradford, England, where steam is supplied to a 2,500-kw. turbine at 1,000 lb. and 800 deg. The new Battersea Station of the London Power Company will generate steam at 645 lb. and 875 deg. F. At the Langerbrugge Station, in Belgium, which has been operating successfully for a number of years at 800 lb. and 840 deg. F., an order has been placed for a new Benson boiler of 3,200-lb. pressure having a peak steaming capacity of 300,000 lb. per hour, an unusually large boiler for Europe. The Klingenberg Station in Berlin, illustrating the latest Continental practice, has sixteen boilers, each with a steaming rate of 160,000 lb. per hour at 500 lb. and 770 deg.

In the seven major generating stations supplying the industrial districts surrounding the city of Paris, steam pressures range from 220 to 550 lb. and temperatures from 600 to 850 degrees Fahrenheit. For an extension to one of the plants, the St. Denis power station, it is significant that a 75,000-hp. turbine designed for a maximum steam pressure of 995 lb. and a temperature of 932 deg., recently has been ordered. These stations soon will be interconnected with the various water-power centers through the French super-power network now under construction.

Application of pulverized fuel seems to be spreading rapidly, particularly in Germany, where it is expected that lignites mixed with other coals may be burned at high efficiency. In 1928 there were in Germany 914 installations in 272 plants, including 545 industrial furnaces and 369 steam boilers, with a large number of additional installations under construction. One of these stations is the large Klingenberg plant in Berlin.

Britain's large powdered-coal plant, the Hams Hall generating station, in Birmingham, was recently reported ready for operation. The initial installation of two 30,000-kw. turbine-generators will be supplied with steam at 375 lb. and 710 deg. F. by five boilers, each of 190,000-lb. per hour capacity, equipped with unit mills.

In France, in spite of low load factors and the abrasive nature of French coals, the Union d'Electricite, after four years of comparative operation with stokers and powdered coal, has adopted the latter method of burning for the new station at Vitry, which was designed for an ultimate capacity of 400,000 kilowatts.

Notwithstanding the recent enthusiasm for powdered coal, it seems that a reaction toward stoker firing has set in. This is resulting from the fly-ash nuisance in residential districts, strict smoke ordinances vigorously enforced, and, in Franch, the difficulty and expense of pulverizing the coal. More flexible stoker designs, the introduction of the American underfeed type, and the adoption of water-cooled furnace walls are giving the flexibility inherent to powdered-coal firing. To illustrate: the London Power Company has adopted stokers for the new Battersea plant; Berlin has pulverized fuel at Klingenberg and is adopting stokers for its new station in a better residential district; the Genoa Station of the Milan Edison Company in Italy uses stokers; and many other instances could be cited.

COAL CARBONIZATION continues to be a subject of great interest. In England alone some sixteen processes are being tried out, with installations having capacities of over 10 tons of coal per day. To produce a suitable fuel and at the same time reclaim the byproducts, Germany is attempting to carbonize its low-grade brown coal.

Steam storage in Europe has been given an impetus by the adoption of accumulators to carry central station peak loads and the development of a special turbine to utilize the storage energy. There are now fourteen installations of this kind in Europe, the largest being the recently completed battery of sixteen vertical accumulators for the Charlottenburg plant in Berlin. The maximum anticipated peak load to be supplied by accumulated steam is 40,000 kw., and the amount of energy delivered during the 2½- to 3-hr. peak is 70,000 kw.-hr.

SOCIETY ACTIVITIES, RESEARCH AND STANDARDIZATION

FOREMOST among engineering conferences during the year were the simultaneous meetings of the World Engineering Congress and World Power Conference at Tokio, Japan, last fall. There for the first time engineering was placed on a firm international basis. At these meetings speakers from every nation emphasized the importance of the part played by engineers in the social, economic and industrial progress of all countries. The vast scope covered by papers presented at the technical sessions alone gave a panoramic outline of present-day engineering achievement, while the value of the interchange of ideas and broadening of viewpoints through personal contacts at the social functions is inestimable.

Of particular importance to the widening horizons of engineering was the crystallization at this conference of the growing sentiment among engineers of all nations for the creation of a world federation of engineers. At the instance of Dr. Stan. Spaeck, of the Czechoslovakian delegation, a resolution was offered advocating such a federation. Although details of the organization are yet to be worked out, there were strong indications at the conference that it would take form in the near future.

Other conferences of international importance in the power field during 1929 were the sectional meeting of the World Power Conference at Barcelona, Spain, in May, and the meetings in London, England, during July, of the advisory committees on steam turbines and electrical machinery of the International Electrotechnical Commission. At the former, attention was focused on the subject of the complete utilization of water-power resources, with papers presented under five headings: general hydro problems, technical problems of water power utilization, economic and financial considerations, and protective measures for hydro undertakings. In an effort to establish a basis of comparison between generating units manufactured in different countries, the latter meetings were devoted to the consideration of international ratings for steam turbines and electrical machinery.

An outstanding contribution to information in the power field was made the early part of the year with the publishing in book form of the first authoritative survey of the world's potential and developed power resources. Under the auspices of the World Power Conference in London, the British economist, Hugh Quigley, compiled this study, which is considered the best of its kind in print.

Whether in society endeavors, research or standardization engineering activities were markedly more international in character during 1929 than ever before. Research, always a leading force in this trend, further broadened in scope through interchange of ideas and discoveries between countries; while even domestic standards were influenced by foreign practice. Reaching a climax at the engineering meetings in Japan, the tendency gained there an immeasureable impetus.

In the United States, activities of engineering societies showed a normal growth during 1929. There was a slight increase in the number of meetings held by the major bodies, with a decided tendency toward wider geographic distribution to include those sections of the country that have recently exhibited marked industrial progress. Evidence of expansion in the power indusy is seen in the greater prominence given to and interest shown in papers devoted to this subject at the technical sessions of the meetings. Economic aspects of power problems were particularly stressed.

The American Society of Mechanical Engineers held five major meetings during the year at widely separated points, as well as thirteen meetings under the auspices of its professional divisions. Of these, many were devoted exclusively to power subjects, while nearly all included in their programs valuable contributions to the field. Of particular interest were the Knoxville, Rochester and annual meetings of the society, and the oil and Gas Power Division and Fuels Division meetings. A feature of the annual meeting was the public hearings on power test codes, which attracted widespread interest. Also, the full discussions of Diesel engine problems at the second Oil and Gas Power Division meeting proved of great value to those in this field; while definite progress in smoke abatement work resulted from the symposium held on this subject at the meeting of the Fuels Division.

The American Engineering Council grew in prominence during the year with the addition to its membership of the American Society of Civil Engineers and the American Institute of Consulting Engineers. Legislative measures for the advancement of the profession, notable among which was a bill before Congress for the establishment of a hydraulic laboratory at the Bureau of Standards, were fostered by the council, as well as the inauguration of a study by engineers of themselves.

Among others of the year's activities worth noting were: the 25th anniversary celebration of the American Society of Refrigerating Engineers; the formation of the Polytechnic Society of New York City, the Diesel Engine Manufacturers' Association, and the Institute of Boiler and Radiator Manufacturers; the expansion of Canadian engineering societies and operating organizations; the progress made in engineering educational methods fostered by the Society for the Promotion of Engineering Education; the inauguration and celebration of

Light's Golden Jubilee by the National Electric Light Association and other engineering organizations.

Presentation of the John Fritz gold metal, the highest honor bestowed by the four founder engineering societies, was made to President Hoover, while Ralph Modjeski was voted the award for this year's achievement. The Edison medal of the American Institute of Electrical Engineers was awarded to Charles F. Scott for his contributions to the science of electric transmission. Allan B. Field, prominent British inventor and consulting engineer, received the Lamme medal for meritorious achievement in the design of electrical machinery. The Chandler medal was awarded to Dr. Irving Langmuir for outstanding achievement in science, and Coffin awards were made to D. D. Chase, T. F. Barton and A. R. Smith for their parts in the development of the double-winding generator.

IN THE field of research 1929 will go down as a landmark of progress in steam investigations. It marks the adoption for the first time of a rational international heat unit and the agreement upon a basic international steam table with specified tolerances. These accomplishments grew out of an international conference of experts held in London last July. The new heat unit, practically equal to the kilogram-calorie, is one kilowatt-hour divided by 860. Reliable steam table values are now available up to 1,800 lb. pressure. United States agencies contributing to progress in steam research were the A.S.M.E. Special Research Committee on the Physical Properties of Steam, the Bureau of Standards, Stevens Institute of Technology, Massachusetts Institute of Technology and Harvard University.

Further valuable contributions to thermal research were made by the research laboratory of the American Society of Heating and Ventilating Engineers, which carried forward inventigations on the thermal resistance of air spaces and heat transfer coefficients. Definite progress was made by the Committee on Heat Transmission of the National Research Council in the determination of properties of insulating materials. Studies on heat transmission in steam boilers and through boiler tubes were concluded by the Bureau of Mines.

Research in the alloys of iron was inaugurated during the year by the Engineering Foundation in co-operation with the American Institute of Mining and Metallurgical Engineers. The foundation also increased its endowment fund through the co-operation in research of the Society of Naval Architects and Marine Engineers, the Batelle Memorial Institute and the Bureau of Standards. Other metallurgical investigations were carried on by A.S.M.E. committees covering the effect of temperature on the properties of metals, condenser tube deterioration, and wire rope utilization.

Research work on "caustic embrittlement" and the sulphate-alkalinity ratio continued through the year and will undoubtedly be active in 1930. Though there is as yet no universal agreement on these matters, considerable progress was made in testing feed-water chemicals by the Navy Department, and investigations were carried forward under supervision of the joint committee of the A.B.M.A., A.R.E.A., A.W.W.A., N.E.L.A., A.S.T.M. and A.S.M.E. A committee was organized by the A.S.M.E. during 1929 to study slagging and the removal of coal ash from boiler furnaces, which should prove a valuable addition to refractory research.

An improved method for measuring fluid velocity and the development of fluid meters were outstanding achievements of research in the hydraulic field during the year. The National Water Power Policies Committee brought its exhaustive study of fuel and water power to the final stages and expects to complete it early in 1930. Definite progress was reported by those engaged in determining the effects of lightning on electric transmission lines.

In the welding field, research developed two new non-destructive tests during 1929, the stethoscope test and the Sperry resistance test. X-ray testing was improved. These tests will go far to satisfy those who hesitate to employ welding for vital structures.

Toward the close of the year an enlarged research program on the subject of lubrication was instituted, which will include the collection of important foreign data and the extension of the present group of closely co-ordinated investigations. These cover the characteristics of an effective lubricant, design of bearing surfaces, and the phenomenon of oiliness. Considerable progress has been made both in this country and abroad in research on turbine oils. Satisfactory processes for aging these oils and tests for determining their properties are being developed.

Additions during the year to research facilities include the installation of a new high-pressure steam laboratory at Purdue University, and the endowment of a research fellowship in electro-chemistry at Columbia University. Plans were announced for the construction of a new $2,000,000 national research laboratory in Canada, and erection of a large technical museum at Chicago was begun.

A NOTABLE development in industrial standardization took place in 1929, when control of the American Standards Association passed from the hands of scientists and engineers to a group of industrial leaders. Following this a co-operative agreement between the association and the Bureau of Standards was ratified whereby the bureau will primarily serve industrial groups having no satisfactory standardization facilities of their own, while the association will concentrate on work with those bodies having such facilities. Toward the end of the year the association became a member body of the International Standards Association.

Among the new standards adopted were those for steel pipe flanges and fittings by the A.S.M.E. Boiler Code Committee, marine boiler designs by the American Marine Standards Committee, coal sizes by the Department of Commerce, piping fabricated by the oxy-acetylene welding process by industrial groups, and condenser leakage tests by the A.S.M.E. Committee on Power Test Codes.

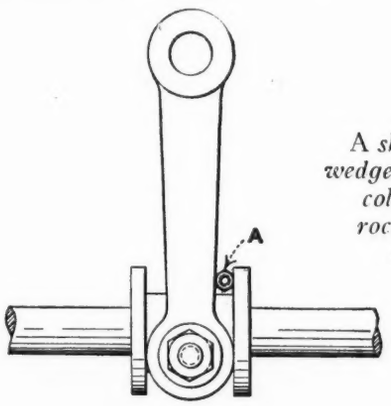
The A.S.T.M. Sectional Committee on Dimensions and Materials of Wrought-Iron and Wrought-Steel Pipe and Tubing formulated a definite program with the A.S.M.E. for the preparation of specifications. A tentative code for pressure piping systems, sponsored by the A.S.M.E., was drafted by the A.S.A., and a test code for liquid fuels was prepared by the Power Test Codes Individual Committee on Fuels. The latter was given a public hearing at the annual meeting of the A.S.M.E.

There was considerable agitation in 1929 for a better unit with which to rate steam boilers. At the annual meeting of the Indiana Engineering Society, Prof. H. L. Solberg, of Purdue University, suggested the use of "thousands of heat units absorbed per hour by steam and water-heating surfaces." No general agreement on this or any other unit, however, was reached during the year.

Right Out of the Plant

Why the Pump Stopped

IN A box factory where I was employed as engineer we had two duplex pumps for supplying the boiler feed. One morning about 9 o'clock the fireman informed me that the pump he had been running had stopped and that the water was getting low in the boilers. The pumps were located in the basement of the engine room, which was poorly lighted. I tried to start the pump, but it



A shows nut wedged between collar and rocker-arm lever

refused to move. Then I discovered the trouble. A ½-in. nut had become wedged between the collar on the piston rod and the rocker-arm lever, as shown in the illustration. When the nut had been removed the pump operated as usual. I could not locate where the nut had come from.

North Cambridge, Mass. W. A. Dow.

Care and Maintenance of Automatic Controls on Heating Boilers

AUTOMATIC devices, such as water feeders or regulators, motor cut-out switches, gas cut-off valves, may be of value in preventing damage to heating boilers from low water if they are:

1. Tested at regular and frequent intervals; by blowing off the float chamber, or lowering the water in the boiler, to see whether the device responds, as intended. This should be done once or twice a week.

2. Properly maintained; by keeping clean, by frequently blowing off the float chamber during the heating season and opening the chambers for examination and cleaning once each year; at which time all moving parts should be carefully examined for deposits or corrosion, which might cause them to stick; also by taking apart the water valves of feeders to note their condition. The best time to dismantle a device is just prior to the heating season, in order to detect damage that may have developed while equipment was idle, as that is when corrosion is most active and when moving parts, especially bearings, or spindles through packings, get stuck.

3. Properly installed; by setting at the correct level and adjusting properly; by providing for blowing out, and connecting with the proper pipes; all as specified by the manufacturer. For water feeders, brass feed pipes between the water valve parts and the boilers are recommended; otherwise scale is likely to deposit, particularly where the pipes enter the boilers.

4. Of adequate capacity (if the device is a water feeder); so that it is capable of maintaining the water in the boiler at a normal level, while operating at maximum capacity, under normal conditions.

On account of the scale-forming and corrosive properties of water, such devices may cause damage instead of preventing it, unless all of these provisions are complied with. Unless such devices are carefully maintained and checked up, too much is being expected of them. Complete reliance should not be placed upon them unless they are taken care of. On the other hand, when properly taken care of, it is believed that they can, in general, be relied upon to operate in an emergency, which is their particular function.

Reliable manufacturers recommend these precautions:

When contemplating the installation of any device on a boiler not already provided with one, all the facts, as stated, should be considered before undertaking the installation.

For boilers equipped with oil burners, a water feeder or a motor cut-off or both can be used. With the former the boiler is protected by keeping the water up to a certain level. With the latter, the boiler is protected by having the fire cut off as long as the water in the boiler remains low. It is evident that either of these, if reliable, should be sufficient. It is customary to provide double protection by having one of each installed.

For gas-fired boilers, it is customary to provide a gas cut-off valve, and in some cases a water feeder is also installed. Either one of these devices should be sufficient.

For coal-fired boilers, only water feeders need be used.

Improvements in the design of these devices are continually being made, but it is hardly possible that they can ever be made so fool-proof that they can be neglected without penalty.

All boiler inspectors should insist on having such devices tested in their presence. The inspector should also ascertain whether tests are being made at regular and frequent intervals. If he finds that they are not, he should issue the necessary instructions to someone in authority.

In my opinion, a water feeder for use on heating boilers should possess the following features (which represent a standard of comparison for rating feeders):

1. The feed water should not pass through the float chamber, so that scale cannot be deposited there. (Credit of 20 points.)

2. The feed valve should be so separated from the float chamber, or the boiler, that the temperature cannot rise above the point at which scale will be deposited (212 deg.). (Credit of 20 points.)

3. There should be as few bearings or stuffing boxes as possible in the float chamber. (Credit of 16 points.)

4. There should be as few bearings or stuffing boxes as possible in the feed-valve chamber. (Credit of 12 points.)

5. The water valve parts should be of non-corrosive material to minimize sticking. (Credit of 12 points.)

6. There should be a generous size and readily remov-

able strainer to keep out gravel, sediment and other foreign matter. (Credit of 8 points.)

7. The assembly should be such that the parts can be readily opened or taken apart for periodic examination and cleaning. (Credit of 8 points.)

8. The float should be large (at least 6 in.) and the leverage ratio high to insure powerful operation of water valve. (Credit of 4 points.)

If a feeder possesses all of these points, it may be rated 100 per cent. If it possesses a total of 80 credit points, its rating is 80 per cent. In counting under features 3 and 4, a discount of 4 points for each bearing should be made. By this count, if there were four or more bearings, or stuffing boxes in the float chamber or three or more in the water-valve chamber, all credit points would be wiped out. It will be noted that most credit is given under features 1 and 2; because they are considered the most important.

I have been making a study for a number of years of this subject, including inspections and collection of data, and in connection with it I have had valuable contact with engineers of leading insurance companies. I feel qualified to set forth the results of my observations and study and to express deductions and conclusions and to suggest a standard of comparison for rating. These data include a record of conditions found by opening numerous water feeders, particularly on boilers which had been damaged due to failures of feeders.

The ratings given have been strikingly justified by failures occurring almost without exception on water feeders with a low rating.

A. J. Loppin, *Asst. Supt.*,
Inspection Dept.,
Fidelity & Casualty Co. of New York.
New York City.

Draining Vacuum and Compressor Lines

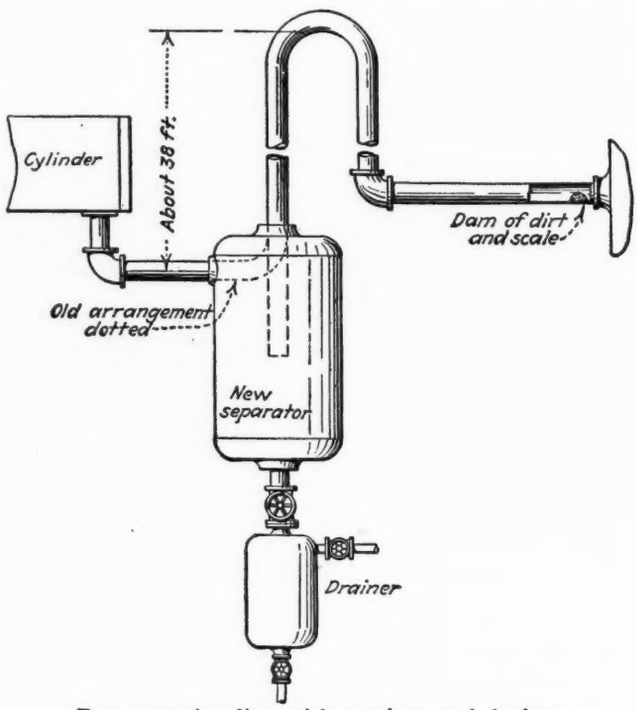
MY ATTENTION has been called to the comments by J. A. Schaffner in the Nov. 5 number of *Power* on my article on "Draining Vacuum and Compressor Lines," which appeared in the Oct. 8 number. To a certain extent, his criticism may be justified, although, like all kinks and home-made equipment, such suggestions must be used with intelligence. If a vacuum trap seems warranted to the engineer he should by all means try to get one. However, vacuum lines, as a rule, do not have a great deal of water to drain out unless they are from a filter or vacuum dryer. Drainers and traps should be used only to drain off condensation and such small amounts of water as collect through cooling of the air and vapor passing through the pipe.

That is for a rotative dry vacuum pump, of course; because a wet vacuum pump requires no such protection. If any considerable amount of water is to be handled other means must be provided for protecting the pump against the water. As to slugs of water, no trap or drainer will give adequate protection unless some type of intermediate receiver or separator is provided, because the drain to the trap is so small and the slug of water is probably traveling so fast that it passes over the drain pipe opening.

It is not unusual to find a loop of pipe preceding a dry vacuum pump, and as this loop is run up into the air around 35 or 40 ft. the engineer feels safe, since he knows water will not be lifted that distance even by a perfect vacuum. This confidence is often misplaced. I know from sad experience.

A number of years ago I was working in a plant where we had vacuum pumps working on a filter drying flotation concentrates. The pump was protected by such a loop. But one night the pump wrecked itself. The crank pin was broken and the connecting rod bent up. The engineer had just drained the line immediately ahead of the pump, so that water was ruled out. It was assumed that the crank pin broke because of a defect.

The same thing happened a few weeks after the pump was repaired. This time the head end of the cylinder was broken off. After this accident a thorough search was made for the source of the slug of water that was responsible. Finally, it was located on the other side of the loop. Although this part of the line was made with



Pump suction line with receiver and drainer

a pitch so that it would drain, sufficient sediment had collected to build a little dam and trap some water. Evidently this water went back and forth like a piston and finally lifted a slug of water into the machine.

This was fixed by running the pipe into a large receiver and changing the direction, so that it acted like a separator. It was, in turn, drained by a smaller drainer such as I mentioned in my previous article. I cannot agree with what Mr. Schaffner says about its giving the engineer a lot of extra work. Does any good engineer let his traps go day after day without trying them to see if they are working properly? Most engineers will do it every time they come on watch, even though they have never known the trap to fail. How many engineers who have never had a bearing burn out make it a point of feeling each one the first thing when they come on shift? And, again, how many engineers will start up a compressor or vacuum pump without first determining if all the drains have been opened and the water all drained out? When he finds one that goes over and throws in the switch—trusting that the drains, jacket water, oil, etc., are all right—it is time to get some one else to take care of the equipment.

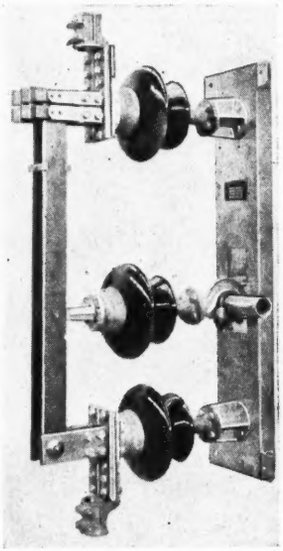
P. F. Rogers.
Brooklyn, N. Y.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Gang-Operated Multi-Pole Switch

A RECENT addition to the line of switching equipment put out by the Delta-Star Electric Company,



Single-pole switch

Chicago, Ill., is a new type of gang-operated multi-pole switch, designated type "B," a single-pole unit being illustrated.

The pivoted center insulator pushes the blade out of and draws in into the floating contacts by means of an interconnected operating mechanism controlled by a common handle. The operating mechanism is so arranged that the center insulator unit is in toggle in both full-open and closed positions. The terminal lugs are of the heavy-duty clamp type. This switch is made for a large range of voltage and ampere capacities, the one illustrated being rated at 15 kilovolts and 1,600 amperes.

Ammonia Float Control and Receiver Drainer

TO PRECLUDE the possibility of liquid ammonia being pulled over into the compressor it is the general practice in refrigerating plants to carry the liquid level much below the top coil, with the result that a big portion of the evaporating surface is not used.

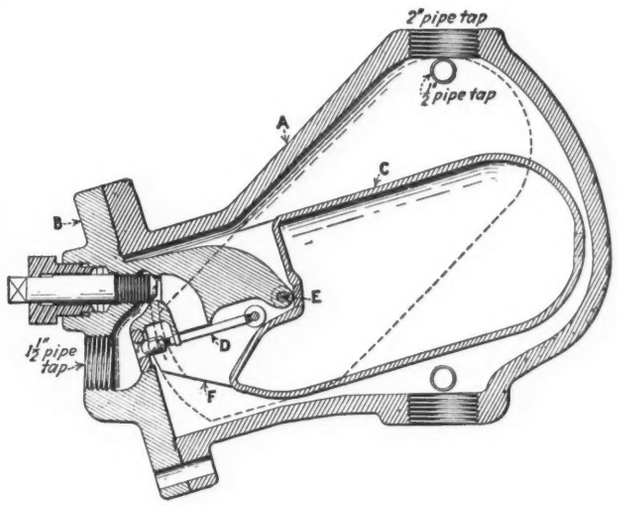
To eliminate the danger of ammonia slugs passing over to the condenser and to permit all the evaporating surface to be used, the ammonia float control illustrated has been developed by D. K. Warner, Bristol, Conn. One of the principal advantages of the control is its small size and light weight in relation to its capacity. It can be placed directly in the pipe line without further support.

Referring to the illustrations, the control consists, essentially, of a cast-iron body *A*, with flanged cover *B*, a counter-balanced cast-iron float *C*, and valve mechanism *D* with removable seat and disk. The float is hinged on a steel pin at point *E*, and the hollow end is counter-balanced by two extensions as at *F* (one on each side of the bracket and valve stem), leaving the buoyancy of the float to operate the valve. The maximum travel of the outer end of the float in the largest size is approximately 3½ in. The valve spindle is attached to the float at a point close to the float fulcrum, but with sufficient offset to give maximum valve opening with normal travel of the float. A removable ball disk and seat of high-carbon chrome steel are interchangeable for the various sizes, according to the service for which the valve is used. These parts can also be furnished of any material best suited to the liquid being handled. The cover *B*, which carries the supporting bracket for the float, and the valve stem and seat are also fitted with a bypass, around the float-operated valve.

In addition to its use as a liquid-level control, it can be used as a receiver or condenser drainer by simply reversing and connecting at the proper point. The accompanying line drawing shows it in position for use as a drainer.

Control valve assembly and cut-away view of float

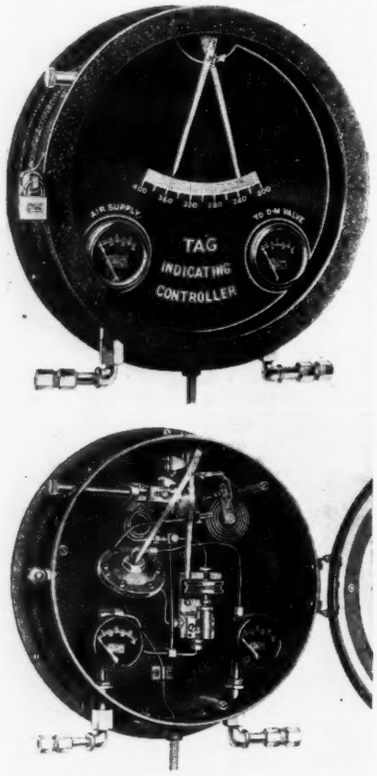
The valve is made in three sizes, of 2, 12 and 125 tons capacity. On the larger size a gage glass is used to show the operating level at all times.



Cross section of valve in position for use as a drainer

New Indicating Controller

IN THE January 22, 1929, number of *Power* the tag-recorder-controller put out by the C. J. Tagliabue Manufacturing Company, 18-88 Thirty-third St., Brooklyn, N. Y.,



Closed and open views of indicating controller

was illustrated and described. To this line has recently been added the indicating controller illustrated.

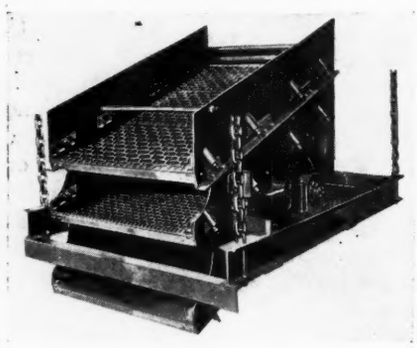
This instrument, which has been designed to meet the demand for a mercury instrument with a wide range, is identical in design with the recorder controller except that it is arranged to indicate the temperature rather than record it. The indicating and setting pointers operate across a scale covering a range graduated in actual degrees.

Some of the important constructional features of the new instrument are: Improved round form case construction with all air gages inclosed within the case and visible through glass windows in the front cover; outside, direct adjustment of the setting pointer; fully compensated mercury system that gives a wide range without sacrifice of accuracy, even with tube lengths up to 150 ft.; swing control, permitting adjustment to suit each individual condition; and a special pilot air valve by means of which throttling control or "on and off" may be had.

Vibrator Screen With Single, Double and Triple Decks

BUILT in different widths and lengths ranging from 2 ft. wide x 4 ft. long to 5 ft. wide x 8 ft. long, the new S-A vibrator screen, illustrated, is being put out in single-, double- and triple-deck assemblies by the Stephens-Adamson Manufacturing Company, Aurora, Ill.

As will be apparent from the illustration, the sub-frame is flexibly suspended from each corner, and the complete screen assembly is mounted on it. Standard screen panels with quick-action clamps and adjustable angle of incline constitute the screening element. The driving shaft is mounted on heavy-duty anti-friction bearings, fitted with bronze grease seals and with pressure lubrication



S-A vibrator screen

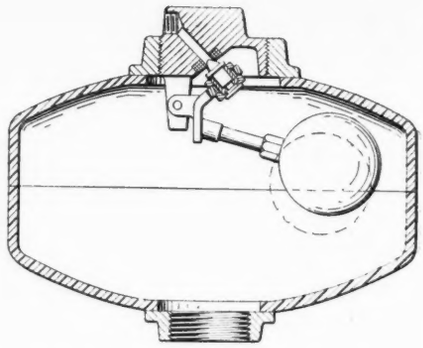
to each bearing. The driving motor is totally inclosed and has forced air ventilation.

To make the screen adaptable to a wide range of duty, four different rotor mechanisms are built for installation in the several assemblies, according to the severity of the duty.

Automatic Air Relief Valves for Varying Pressures

MANUFACTURED in three types by the Automatic Primer Company, Chicago, Ill., the relief valve illustrated is designed to discharge automatically accumulations of air from pipe lines, pumps and various kinds of tanks. The valve will pass air both in and out, but will close at once on liquids. By inserting a vacuum ball in the head of the valve, air will be passed in one direction only.

The smallest valve, made in $\frac{3}{8}$-, $\frac{1}{2}$-, and 1-in. sizes, is good for pressures up to 125 lb., with venting capacities of as high as 20 cu.-ft. per



Relief valve with large chamber

minute at 60-lb. pressure. When larger amounts of air are to be relieved, a second type of valve, actuated by a float, is recommended. On account of the size of the valve chamber, this valve also serves as an air accumulator. It can be used under pressure conditions not exceeding 200 lb. For higher pressures, a third series is available that will withstand pressure as high as 500 lb. per square inch.

Kerosene Torch Preheats Metal for Welding

PREVIOUS to welding heavy pieces with the oxy-acetylene torch, it is usually advisable to preheat the section to eliminate the warping or cracking that would occur if a cold weld were attempted.

To facilitate this work where the piece cannot be conveniently put over a forge or other preheating furnace, the St. Paul Welding & Manufacturing Company, St. Paul, Minn., has

Torch with supply tank

brought out a portable kerosene torch known as the Torit 8-K, which throws a flame about 2 ft. long. Fuel is supplied to the torch from a 10-gal. tank through 10 ft. of hose. It is equipped with a double-acting pump and the tank can be refilled while the torch is in operation.

Events and Men in Powers' Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

Spot * News

ERECTION *and operation of a large hydro-electric plant on the St. Lawrence River by the State of New York and construction of transmission lines under State auspices with retention by the State of the title were advocated by Governor Roosevelt in his annual message to the Legislature on Jan. 1.*

* * *

RECORD LOADS *occurred on utility systems in many parts of the country during December. On Dec. 17 the New York Edison system was called upon to furnish 17,289,820 kw.-hr., the heaviest load ever carried. A peak load of 536,600 kw. was recorded by the Public Service Electric & Gas Company of New Jersey on Dec. 16, and a new high was hit by the Public Service Company of Colorado on Dec. 17 with a maximum demand of 67,800 kw.*

* * *

GROSS REVENUES *of public utility power companies were $2,050,000,000 in 1929 as compared with $1,920,000,000 in 1928, according to an estimate of Pynchon & Company, issued Jan. 1.*

* * *

CULMINATING *two years of construction work, operation of the first 35,000-kw. unit has been started at the India Basin plant of the Great Western Power Company of California. Present plans call for the installation of three additional units of the same size, giving an ultimate capacity of 140,000 kw.*

Live Technical Program a Feature of A.I.E.E. Winter Convention

ONE of the most interesting technical programs ever offered by the American Institute of Electrical Engineers will be presented at its 1930 winter convention to be held in New York City, Jan. 27-31. Other attractive features are also being planned for the entertainment of those attending. These include inspection trips, a lecture, the Edison medal presentation to Charles F. Scott, a smoker, and a dinner dance.

The technical papers will cover the subjects of protective devices, power-system planning, field investigations of lightning, transoceanic telephony and telegraphy, dielectrics, welding, and electrical machinery. Among those of particular interest to the power field are the following:

"Metal-Clad Switchgear at the State Line Station," by A. M. Rossman, Sargent & Lundy, Inc., Chicago; "Development of the New Autovalve Arrester," by J. Slepian, R. Tanberg and C. E. Krause, Westinghouse Electric & Manufacturing Company; "Thyrite, a New Material for Lightning Arresters," by K. B. McEachron, General Electric Company; "Extinction of a Long Alternating-Current Arc," by J. Slepian, Westinghouse Electric & Manufacturing Company; "Use of Oil in Arc Rupturing with Special Reference to System Stability," by B. P. Baker and H. M. Wilcox, Westinghouse & Manufacturing Company.

"System Connections and Interconnections in the Chicago District," by G. M. Armbrust and T. G. Le Clair, Commonwealth Edison Company; "Fundamental Plan of Power Supply in the Detroit District," by S. M. Dean, Detroit Edison Company; "Turbine-Generator Tests at Colfax Power Station," T. C. Purcell and A. P. Hayward, Duquesne Light Company; "Controlling Power Flow With Phase-Shifting Equipment," by W. J. Lyman, Duquesne Light Company.

"Cathode Energy of the Iron Arc," by G. E. Doan, Lehigh University; "Resistance Welding," by B. T. Mottinger, Federal Machine & Welder Company; "Electrically Welded Structures Under Dynamic Stress," by Morris Stone and J. G. Ritter, Westinghouse Electric & Manufacturing Company; "Welding With the Carbon Arc," by J. C. Lincoln, Lincoln Electric Company; "Conductivity of Insulating Oils," by J. B. Whitehead and R. H. Marvin, Johns Hopkins University.

"Loading Transformers by Temperature," by V. M. Montsinger, General Electric Company; "Recommendations for Safe Loading of Transformers by Temperature," by W. M. Dann, Westinghouse Electric & Manufacturing Company; "Tap Changing Under Load for Voltages and Phase-Angle Control," by H. B. West, Westinghouse Electric & Manufacturing Company.

A New Year Resolution

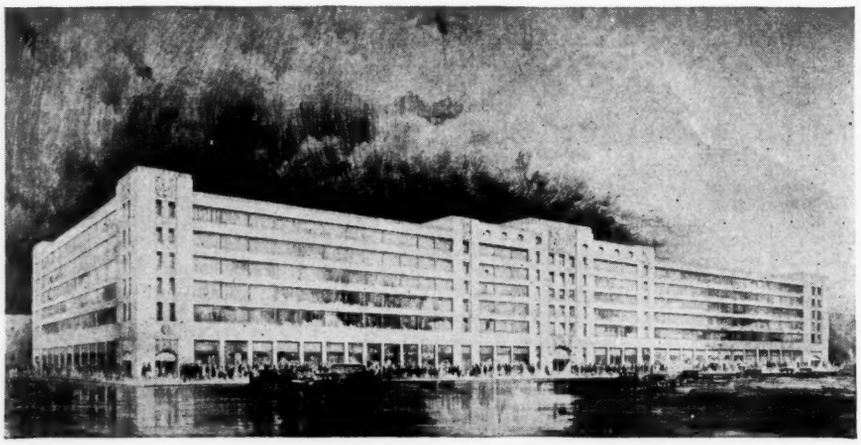
IT IS customary with the coming of the new year to declare again the principles and resolutions that shall guide one's relations with his fellow-men. It is gratifying too, that in keeping with the season, the force of the Christmas spirit gives added strength to the knowledge and determination that bigger and better things will come to us only as they benefit our neighbors too.

No pledge will be complete this year unless, among other promises, it also resolves to give full co-operation to the efforts of President Hoover and his conferees to prevent a trade recession and the development of hard times throughout the country.

FORMERLY a stock market break such as that of last October inevitably resulted in general business depression. By his leadership the President has, in the present instance, undertaken a profound economic experiment designed to prevent this. Its success is vitally important to all. It is generally felt that success or failure will depend upon the events of the next three months.

Every person should turn away from the Wall Street cataclysm and proceed now, to live normally in work and play, neither spending nor saving more than is customary. We shall be certain then, of a genuinely happy and prosperous New Year.—The Editor.

Plan Permanent Exhibit and Laboratory for Machinery Developments



Architects's sketch of the new machinery exhibit and laboratory building to be erected in Detroit by MacDonald Brothers

TO PROVIDE a permanent display of the latest developments in the machinery of all industries, the MacDonald Brothers Engineering Laboratories, Inc., Boston, Mass., will start erecting an enormous laboratory and machinery exhibit building in Detroit, Mich., next March. The building when completed will contain one million square feet of floor surface and is considered of sufficient size to house approximately one thousand permanent exhibits. Financing for the project is completed and general plans are practically finished. Details and some questions of space requirements for various exhibits have prevented the settlement of some of the building dimensions up to the present.

Large Development Planned For Cheat River

The development of hydro-electric plants with a capacity in excess of 600,000 hp. is proposed in an application filed Dec. 20 by the West Virginia Power & Transmission Company, a subsidiary of the West Penn Electric Company, with the Public Service Commission of West Virginia.

An extensive water-power development is planned along the Cheat River watershed in five counties in the northern and central parts of the state, according to the application. Estimated capacity of the proposed hydro-electric plants was fixed by the applicant company at "in excess of 600,000 hp." and it was added in the application that the developments will require as a condition precedent to their construction and operation, a steam-electric generating system to carry the base load, with a total generating capacity of approximately twice the capacity of the water-power developments.

The first construction planned is a storage dam, 78 ft. high, on Blackwater River. This, company engineers estimate, could be constructed within ten months. Six months after construction of the storage dam, the application says, the company will begin construction on the Blackwater of a diversion dam, 55 ft. high, to divert water through tunnels or conduits to a power house having a capacity of 58,000 hp. A third project planned on the Blackwater is a diversion dam, 98 ft. high, to send water through tunnels to a second power house of 58,000 hp. capacity. Construction is to be started one year after the first diversion dam is completed. Each of the diversion dams could be constructed in one and one-half years. A tentative construction date also is fixed for a project at Beaver Hole consisting of a dam 106 ft. high and a power house with a capacity of 86,000 hp. Construction will be started there, the application says, two and one-half years after the final Blackwater project is completed and is expected to require two years.

North American Co. Plans Large 1930 Expansion

The North American Company's subsidiaries are providing for 14 per cent more expenditures during 1930 for additions to plants and systems than will be spent during 1929, according to a statement by President Frank L. Dame.

"Estimates of 1930 construction budgets for the North American System," Mr. Dame said, "aggregate upward of $100,000,000 for new work authorized, including new projects and amounts carried over from this year in connection with large construction programs falling naturally into two or more calendar years. Of this amount it is estimated that about $57,000,000 will be expended during 1930, as compared with $50,000,000 expended during 1929. The figures do not include expenditures for maintenance, which will approximate $11,000,000 for 1930.

"These estimates provide for largely increased activities in the various groups of properties, especially in the construction of additions to distribution systems, supplementing the several major programs of new plant construction, and additions actually completed during 1929. The latter included a new steam-electric generating station at San Francisco, and large additions to Cahokia plant near St. Louis, Avon plant near Cleveland, Lakeside plant at Milwaukee and Benning plant at Washington. Substantial allowances were made for work under way on a new steam plant at Ashtabula, Ohio, the hydro-electric plant and dam on the Osage River at Bagnell, Mo., and the contemplated steam plant at Port Washington, Wis."

Diesel Mfrs. Association Elects Officers

The Diesel Engine Manufacturers' Association has announced the election of the following officers for 1930: President, A. E. Ballin, McIntosh & Seymour Corporation, Auburn, N. Y.; vice-president, George Codrington, Winton Engine Company, Cleveland, Ohio; chairman of the executive committee, E. T. Fishwick, Worthington Pump & Machinery Corporation, New York City; chairman of the technical committee, H. W. Dow, Nordberg Manufacturing Company, Milwaukee, Wis.; secretary and treasurer, H. A. Pratt, Ingersoll-Rand Company, New York City.

This Association came into active operation during the year 1929, and in a relatively short time the members have agreed upon a number of engineering standards which should be of assistance to buyers. These agreements will be formally presented in the near future in a book—"The Standards of the Diesel Engine Manufacturers' Association." The association has also served as a vehicle for collective cooperation with the activities of other agencies. Most noteworthy among these is the work of the American Society of Mechanical Engineers in the standardization of fuel oil.

New Award for Service to Engineers

The American Association of Engineers will in the future endeavor each year to award the Claussen Gold Medal to the citizen of the United States (engineer or otherwise) who has during the preceding year performed the most distinctive service for the welfare of engineers—social, economic, or both. It is not to be awarded for engineering or scientific achievements unless they have served very definitely and directly to promote the social and economic welfare of engineers. The first award will be made for services rendered prior to Jan. 1, 1930.

Designed by Elwyn Giles and ex-

ecuted by Amos Massolini, the medal is named in compliment to Henry W. Claussen, Chicago, who has given the association commendable service for the past fifteen years, as officer, director, committee chairman and national treasurer.

The committee on awards invites nominations of persons to receive this medal. They should be sent to the chairman, G. M. Butler, dean of the College of Mines and Engineering, University of Arizona, Tucson, and should include fairly complete bibliographies of nominess as well as a full statement of the services rendered which would seem to make them eligible for the award. While nominations made by individuals will be carefully considered, those offered by national, regional, state, or local groups will naturally carry more weight with the committee and are particularly invited. The first award of the medal will probably be made late next spring.

$40,000,000 Budget for 1930 Announced by P. G. & E. Co.

A budget of $40,000,000 for 1930 has been set up by the Pacific Gas & Electric Company, San Francisco. Of this amount $35,000,000 will be expended on construction of new projects, and $5,000,000 on normal expenses and improvements throughout its system, according to announcement of A. F. Hockenbeamer, president.

In the electrical field, $16,000,000 will be required for the Mokelumne River development. This project, scheduled for completion in 1931, will add 228,000 hp. to the company's electric power supply. This $16,000,000 will be allotted as follows: to the Salt Springs dam $4,000,000; to the Tiger Creek power house, including a 20-mile concrete canal from the dam to the plant, $7,000,000; the year's work on the construction of the Mokelumne-Newark transmission line, $3,000,000; and enlarging the Newark substation, $1,786,000.

On the reconstruction of Station "A", the San Francisco steam plant, $4,000,000 will be spent, and $600,000 will be expended in enlarging the Bear River and Wise canals in Placer County to increase generating capacity of the Halsey and Wise.

Sherwood F. Jeter Dies

Sherwood F. Jeter, vice-president of the Hartford Steam Boiler Inspection & Insurance Company, Hartford, Conn., died Dec. 31 at his home in West Hartford.

Mr. Jeter was born in Columbus, Ga., in 1872. He was graduated from the Georgia School of Technology in 1893 with a B.S. degree in mechanical engineering. He entered the electrical field in lighting, power, and street-railway work and spent a year in Mexico City on telephone work as an electrician for the Mexican Telephone Company.

In 1898 Mr. Jeter became connected with the New Orleans department of the Hartford Steam Boiler Inspection and Insurance Company as inspector of boilers. He remained with the company in New Orleans, Pittsburgh and Hartford until 1906, with the exception of nine months, when he re-entered the street-railway field as master mechanic for the Pittsburgh, McKeesport and Connellsville Railway Company. In 1906 he became mechanical engineer for the Bigelow Company at New Haven. While with this company he redesigned the Hornsby water-tube boiler to meet

Sherwood F. Jeter

manufacturing and operating conditions in the United States.

During the latter part of 1910 Mr. Jeter returned to the Hartford Steam Boiler Inspection and Insurance Company as supervising inspector in charge of inspection work throughout the United States, and in 1915 he was made chief engineer. Later he was made vice-president of the company, which position he held until the time of his death.

Mr. Jeter was a past vice-president and past manager of the American Society of Mechanical Engineers. He served on the society's Boiler Code Committee, Executive Committee and a number of special committees. He was also active in the work of the Hartford Section of the A.S.M.E., being chairman in 1920-21.

Arthur D. Pratt Dies

Arthur D. Pratt, assistant advisory engineer of the Babcock & Wilcox Company, New York City, died Dec. 31 at his home in Short Hills, N. J. He was born in Brooklyn, N. Y., Oct., 1882.

Graduating from Princeton University in 1904, Mr. Pratt spent two years doing graduate work at Massachusetts Institute of Technology. In 1906 he entered the testing department of the B & W company at Bayonne, N. J., where he engaged in boiler and plant testing and experimental work with power-plant equipment. He was made assistant to the advisory engineer in 1911, and devoted his time to general boiler engineering and various research investigations. Particularly interested in the utilization of waste heat, he played an important part in the development of the modern waste-heat boiler.

News of Canada

Review of Power Development During 1929

THE steady growth of water-power development witnessed throughout Canada during the past few years was substantially maintained during 1929. This is disclosed in the annual review just issued by the Dominion Water Power Branch of the Department of the Interior. The total capacity of new installations brought into operation during 1929 amounted to 378,400 hp., making the total installation for the whole Dominion to 5,727,600 hp. There are, as well, a number of important undertakings under active construction which will add more than 1,600,000 hp. to this total during the next three years. The capital expenditure involved in the development, transmission and distribution of this new power is a very considerable proportion of the total expenditure in building construction in Canada, the 1929 outlay involving probably more than $75,000,000, while not less than $320,000,000 will be required to complete the undertakings planned for the next three years.

Quebec

Quebec leads in the magnitude of projects under way and in those completed in 1929. Over 208,000 hp. was added to water power installations in this province, while new undertakings and extensions to existing plants actually under construction will add a further 1,000,000 hp. The 208,000 hp. placed in operation included principally the new plant of the Montreal Island Power Company on des Prairies River near Montreal and the addition of several large units to the existing stations of the Gatineau Power Company and the Shawinigan Water & Power Company.

At Chute-a-Caron, on the Saguenay River construction was actively carried on throughout the year on the hydro-electric development of the Alcoa Power Company. The first stage of the development will consist of four 65,000-hp. units, and will be in operation in 1931. The Beauharnois Light, Heat & Power Company has commenced construction on its development on the St. Lawrence River. The first units of the project are to be in operation by October, 1932, supplying between 200,000 hp. and 350,000 hp., the initial development being designed for 500,000 horsepower.

British Columbia

With construction actually under way in 1929 and projects under investigation for early development, hydro-electric activity in British Columbia is the greatest in the history of the province. Among the subsidiaries of the British Columbia Power Corporation, the Vancouver Island Power Company completed and placed in operation during 1929 a 2,000 hp. installation at its Jordan River diversion dam. At the main Jordan River power station plans

have been prepared and work commenced on the installation of a fourth unit of 18,000 hp., which it is expected will be in operation in 1930. A second subsidiary, the Western Power Company of Canada, commenced active construction during 1929 of the initial stage of an ultimate 188,000-hp. development at Ruskin on the lower Stave River. A third subsidiary, the Bridge River Power Company, continued construction of its undertaking on the Bridge River, the program for which has been altered somewhat due to the placing under construction of the Ruskin development. The initial development may be increased to 80,000 hp., instead of the 56,0000 hp. originally planned, and will come into operation in 1932.

Ontario

In Ontario installations totalling 48,750 hp. were added during the year while other undertakings under way will increase the province's total by 123,000 hp. during 1930. New developments completed during 1929 included the 28,200-hp. plant of the International Nickel Company at the Big Eddy dam on the Spanish River and one of the Algoma District Power Company at High Falls on the Michipicoten River with an initial installation of 11,000 horsepower.

The Ontario Hydro Electric Power Commission completed three new developments during the year: one with an installation of 2,200 hp. at Trethewey Falls on the South Muskoka River to supplement the supply to the Georgian Bay System; another at Elliot Chute on the South River with an installation of 1,800 hp. to supply the Nipissing System, and a third with a 5,000-hp. installation at the power storage dam built at Lower Ear Falls.

Obituary

H. H. Noble, a pioneer in the California hydro-electric development field, died in San Francisco Dec. 19, at the age of 85. In 1900 he organized the Keswick Electrical Power Company in Shasta County, which was one of the first attempts to generate electricity from California waters. Later he was joined by Eugene de Sabla and John Martin, and out of this association grew the Northern California Power Company, which eventually was consolidated with the Pacific Gas & Electric Company. At the time of his death Mr. Noble was president of the Cypress Lawn Cemetery Association.

James Watson, founder and treasurer of Watson & McDaniel Company and and a pioneer in the steam specialty industry, died Dec. 15, at his home in Philadelphia, Pa. Mr. Watson was born in that city on Oct. 26, 1837. Graduating from the Friends Farm School, he entered the firm of Watson & Evans, safe manufacturers, the senior member of which was Mr. Watson's father. They later purchased the interest of Mr. Evans, and the firm name was then changed to J. Watson & Son. At the death of his father, Mr. Watson continued the manufacture of safes until 1878, when he formed a partnership with John S. McDaniel, known as Watson & McDaniel Company, manufacturers of steam specialties.

O'Brien Predicts Steady Utility Growth

"THERE is every reason to believe that the electric and gas industries will continue to expand and increase earnings at a substantial rate during 1930. Construction programs, as already planned and announced, are large, and were made to serve increasing public demands of a fundamental character. Major projects, so far as I know, will be carried out as planned in 1930 in the absence of anything in the present situation to warrant lack of confidence in the growth and prosperity of the United States.

"So far as can be ascertained there is nothing approaching an over extension or over production of electric and gas facilities or service. The facts point to the contrary, and this is why expansion will continue on a reasonable earnings basis. Large additional fields of service await development. Much remains to be done to further interconnect electric systems, and in the long-distance transmission of gas. Due to decreased rainfall there is a shortage of hydro-electric power in the North and West. Even without such shortage additional steam-electric capacities are needed and will be provided.

"One important phase of electric and gas development deserves careful consideration by the public and its lawmakers. This is the sharply increasing degree of competition which both these industries face in their future progress. Electric power from central stations now has to fight its way against higher efficiencies than formerly obtained in isolated plants, both steam and internal-combustion engines. Overproduction of coal and oil cause lower prices of fuel. These conditions extend to the household, where the largest potential uses of electricity and gas are for cooking and heating. The introduction of electric refrigeration is distinctly competitive, and so is the extension of electric service to the farms."—*Statement by John J. O'Brien, president, Standard Gas and Electric Company.*

Personals

Fred Beebe, formerly boiler engineer at the Campbell plant of the Youngstown Sheet & Tube Company in Youngstown, Ohio, is now in the power department of the Dow Chemical Company at Midland, Mich.

Roy R. Cowles, since 1921 assistant engineer in the Pacific Gas & Electric Company's department of distribution and steam engineering, has been transferred to the company's department of electrical construction and operation under F. R. George.

J. E. N. Hume has been appointed assistant manager of the industrial department of the General Electric Company, and has been succeeded by C. F. Pittman as manager of the motor division of the department.

William McPherson, dean of the Graduate School of Ohio State University, became president of the American Chemical Society on Jan. 1, as a result of the society's annual election. Dean McPherson will serve during 1930, succeeding Dr. Irving Langmuir, associate director of research of the General Electric Company. Moses Gomberg, professor of chemistry in the University of Michigan, was chosen president for 1931. In accordance with a recent change in its constitution, the society now elects each year a president and president-elect, who serve in successive years.

J. H. Belknap was recently appointed manager of the control engineering department of the Westinghouse Electric & Manufacturing Company to succeed E. B. Newill, who resigned to become assistant to the president of the Delco Products Company.

S. S. Evans, for the past two years head of the engineering department of the Empire District Electric Company, Joplin, Mo., and for nearly ten years a member of the Empire organization, has been made manager of the Defiance division of the Toledo Edison Company.

Frank H. Brooks has been appointed a member of the Water and Power Commission of the City of Los Angeles to succeed John R. Richards, who resigned recently. Mr. Brooks' appointment has just been confirmed by the Los Angeles City Council.

T. W. Frech, vice-president of the General Electric Company, has been granted a year's leave of absence, effective Jan. 1, to become president of the R. C. A. Radiotron Company. G. C. Osborn and W. T. L. Cogger have resigned from the General Electric to take positions as vice-presidents of the R. C. A. company.

Business Notes

Worthington Pump & Machinery Corporation, Harrison, N. J., announces the removal of its Chicago district sales offices from the Old Colony Building, 37 West Van Buren St., to Room 800, Chicago Daily News Building, 400 West Madison Street.

Barrett-Cravens Campany, Chicago, Ill., announces its affiliation in ownership and management with the Walker Vehicle Company of Chicago and the Automatic Transportation Company, Inc., of Buffalo, N. Y.

Wagner Electric Company, St. Louis, Mo., announces the removal of its Chicago sales office and service station to 1935 Indiana Avenue.

Ironton Fire Brick Company, Ironton, Ohio, has appointed the King Coal & Supply Company, Gay & Asquith Sts., Baltimore, Md., as its representative in Baltimore.

Sullivan Machinery Company, Chicago, Ill., announces the establishment of a branch office at Johannesburg, South Africa, known as the Sullivan Machinery Company, Africa (Proprietary) Ltd., Geneva House, Johannesburg Transvaal. Charles C. Smith, formerly of the Sullivan staff but more recently manager for Barlow's Johannesburg (Proprietary) Ltd., Sullivan agents in South Africa, will be manager of the new office.

Yeomans Brothers Company, Chicago, Ill., announces the election of D. W. Burgoon to the position of vice-president and general manager. Mr. Burgoon will be in charge of all operations of the company, including, as in the past, general supervision of sales.

Coming Conventions

American Society of Mechanical Engineers. Fiftieth Anniversary Celebration at New York City, Hoboken, N. J., and Washington, D. C., April 5-9, 1930. Semi-Annual meeting at the Hotel Book-Cadillac, Detroit, Mich., June 9-12, 1930. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. Annual winter convention at New York, N. Y., Jan. 27-31, 1930. F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating & Ventilation Engineers. Annual meeting in Philadelphia, Pa., Jan. 27-30, 1930, at the Benjamin Franklin Hotel. Secretary, A. V. Hutchinson, 33 W. 39th St., New York City.

Canadian Electrical Association. Annual Convention at the Manoir Richelieu via the S.S. "St. Lawrence," June 11-13, 1930. Secretary, H. M. Lyster, 405 Power Building, Montreal, Quebec.

Engineering Institute of Canada. Annual meeting at the Chateau Laurier, Ottawa, Ont., Feb. 12-14, 1930. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

International Heating & Ventilating Exposition. Commercial Museum, Philadelphia, Pa., Jan. 27-31, 1930. Manager, C. F. Roth, Grand Central Palace, New York City.

International Congress for General Mechanics at Liege, Belgium, Aug. 31 to Sept. 7, 1930. For information address Alb. Schlag, 4 Place Saint-Lambert, Liege, Belgium.

National Electric Light Association. Annual convention at Municipal Auditorium, San Francisco, Calif., June 16-20, 1930. Secretary, A. J. Marshall, 420 Lexington Ave., New York City.

National Marine Engineers' Beneficial Association. Annual convention and exhibition of power machinery at Hotel Barlum, Detroit, Mich., the week of Feb. 10, 1930. Secretary, A. L. Jones, 9th St. and Mount Vernon Place, N. W., Washington, D. C.

New England States Association of the National Association of Power Engineers. Annual convention and exhibition of power machinery at the State Armory, Salem, Mass., June 19-20, 1930. Secretary, E. S. Daniels, 113½ Bridge St., Salem, Mass.

Trade Catalogs

Fume Absorbers—A new edition of its illustrated bulletin 4-R, describing the S & K obnoxious vapor condensers, or fume absorbers, has just been published by the Schutte & Koerting Company, 12th and Thompson Sts., Philadelphia, Pa.

Lubrication—Details of the first completely automatic grease-lubricating system are given in an illustrated folder recently issued by the Keystone Lubricating Company, 21st, Clearfield and Lippincott Sts., Philadelphia, Pa. The folder depicts a steel mill application of the system.

Pump Regulation—Excess pump pressure regulators are described and illustrated in a recent bulletin, No. X-100, of the Leslie Company, Lyndhurst, N. J.

Boilers—A new 8-page illustrated bulletin of the Combustion Engineering Corporation, 200 Madison Ave., New York City, contains a description of VM-Type bent-tube boilers designed especially for limited space conditions, particularly where the head-room is low.

Compressors—Type 30 two-stage, air-cooled, ball-bearing compressors are described and illustrated in an attractive booklet recently issued by the Ingersoll-Rand Company, 11 Broadway, New York City.

Insulators—A new circular, entitled "Westinghouse Apparatus Insulators," has been issued recently by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This 20-page illustrated booklet gives information and test data on the company's new complete line of outdoor apparatus insulators.

Instruments — Bulletin 1255, recently published by James G. Biddle, 1211-13 Arch St., Philadelphia, Pa., describes and illustrated a new "bridge-meg" resistance tester with a range of from 0.01 ohm to 100 megohms.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.25 @$2.50
Kanawha	Columbus	1.30 @ 1.60
Smokeless	Cincinnati	2.00 @ 2.25
Smokeless	Chicago	2.00 @ 2.25
S. E. Kentucky	Chicago	1.30 @ 1.60
Steam	Pittsburgh	1.50 @ 1.75
Gas Slack	Pittsburgh	1.00 @ 1.20
Big Seam	Birmingham	1.25 @ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75@$3.00
Barley	New York	1.40@ 1.50

FUEL OIL

New York—Jan. 2, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Dec. 24, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.695 per bbl., or 42 gal.; 26@28 deg., $1.745 per bbl.; 28@30 deg., $1.795 per bbl.; 30@32 deg., $1.845 per bbl.; 32@36 deg., gas oil, 5.026c. per gal.; 37@40 deg., distillate, 5.73c. per gal.

Pittsburgh—Dec. 18, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5.25c. per gal.

Philadelphia—Dec. 28, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Dec. 31, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Dec. 20, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 85@90c. per bbl.; 26@30 deg., $1.02½@$1.07½ per bbl.; 30@32 deg., $1.30@$1.35 per bbl.

Boston—Dec. 23, tank-car lots, f.o.b., 12@14 deg., Baumé 4.25c. per gal.; 28@32 deg., 5.4c. per gal.

Dallas—Dec. 28, f.o.b. local refinery 26@30 deg., $1.35 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., San Diego—San Diego State Teachers College, received lowest bid on the construction of a training school building including power house and shop from H. Mayson, 229 Euclid Ave., Long Beach. $137,645. G. B. McDougall, Public Works Bldg., Sacramento, is state architect.

Calif., San Francisco—Pacific Gas & Electric Co., 245 Market St., will build a 4 story electric generating plant at 23rd and Georgia Sts. Estimated cost $400,000.

Conn., Hartford—Southern New England Ice Co., R. G. Hadley, 48 Edwards St., is having plans prepared for the construction of an ice manufacturing plant. Estimated cost $150,000. Private plans.

Conn., Hartford — U. S. Veteran's Bureau, Arlington Bldg., Washington, D. C., will receive bids until Jan. 30, for the construction of a group of buildings including boiler plant, refrigeration and ice making plant, oil burning equipment, etc., at U. S. Veteran's Hospital here.

Ga., Atlanta—U. S. Cold Storage Warehouse Co., West Pershing Rd., Chicago, Ill., awarded contract for the construction of a cold storage warehouse and office at Central Ave. and Taylor St. to E. W. Sproul, 2001 Pershing Rd., Chicago, Ill. Estimated cost $3,000,000.

Idaho, Boise—Boise Hotel Co., will receive bids until Feb. 1, for the construction of an 11 story hotel including steam heating, ventilation and refrigeration systems, boilers, pumps, elevators, etc., at Eighth and Bannock Sts. Estimated cost $630,000. Tourtellette & Hummel, Failing Bldg., Portland, Ore., are architects. F. W. Hull, Olympia Hall, Seattle, Wash., lessee.

Ill., Chicago—Young Mens Christian Association, 19 South La Salle St., will receive bids about Feb. 1 for superstructure of a 23 story hotel including central refrigeration plant, swimming pool, elevators, etc., at Chicago Ave. and North Dearborn St. Estimated cost $2,700,000. Perkins, Chatten & Hammond, 60 North La Salle St., are architects. F. A. Randall, 222 North Wells St., is structural engineer. Contract let for foundation of wood pile and caissons.

Ind., Evansville — Bd. of Trustees, Waterworks Dept., J. C. Males, Secy., will receive bids until Jan. 16, for extensions and improvements to waterworks including pumping station, etc. Black & Veatch, 700 Mutual Bldg., Kansas City, Mo., are engineers.

Ind., Putnamville — State Farm, had plans prepared for the construction of a power house. Estimated cost $60,000. Private plans.

Ky., Louisville—Louisville Gas & Electric Co., 311 West Chestnut St., plans additions and extensions to gas and electric distribution system and general construction during 1930. Estimated cost $5,000,000. Byllesby Engineering & Management Corp., 231 South La Salle St., Chicago, Ill., is engineer. Work will be done by owners forces

La., Lutcher—Louisiana Ice & Utilities Co., is having plans prepared for the construction of an ice and power plant. Estimated cost $50,000. Sam Stone Jr. & Co., Masonic Temple Bldg., are architects.

La., Thibodaux—City voted $200,000 bonds for plant for pumping water from the Mississippi River, also purification plant and distribution system.

Md., Glen Arm — School Sisters of Notre Dame, Charles St. Ave., is having plans prepared for the construction of a 3 and 4 story sanitarium, including power plant, oil burning equipment, etc Estimated cost $500,000. B. Evander, 20 East Lexington St., Baltimore, is architect.

Mich., Detroit—Public Lighting Commission, East Atwater St., will receive bids until Jan. 6 for the construction of a sub-station for municipal lighting system on Greenfield Ave. Estimated cost $60,000. Smith, Hinchman & Grylls, 800 Marquette Bldg., are engineers. Electric sub-station equipment (later).

Mich., South Haven — City is having plans prepared for addition to power plant including 550 hp. boiler and coal and ash handling equipment. Estimated cost $100,000. S. H. Smith, City Hall, is engineer.

Miss., McComb — Southern United Ice Co., F. Y. McConglish, Dist. Engr., plans to remodel ice plant. Estimated cost $75,000. Work will be done by owners forces.

N. J., Jersey City—Bd. of Chosen Freeholders, Court House, will receive bids until Jan. 9, for the construction of a refrigeration system for Hudson County Penitentiary. Estimated cost $15,000. F. J. Radegan, Court House, is county engineer.

N. J., Jersey City—Pennsylvania R.R. T. J. Skillman, Pennsylvania Station, New York, N. Y., is having plans prepared for the construction of second unit of cold storage plant and warehouse at Exchange Pl. and Hudson River here. Estimated cost $1,000,000. Terminal Development Co., 25 Church St., New York, N. Y., is engineer. Pennsylvania Dock Co., 25 Church St., New York, is lessee.

N. J., Kearny—Mountain Ice Co., 51 Newark St., Hoboken, will build addition to ice plant on Passaic Ave., here. Estimated cost $40,000. Private plans.

N. Y., Brooklyn—Rubel Coal & Ice Co., 937 Fulton St., will soon award contract for addition to ice manufacturing plant at India Wharf and Conover St. Estimated cost $40,000. H. J. Nurick, 44 Court St., is architect.

N. Y., New York—Bd. of Transportation, J. H. Delaney, 250 Hudson St., will receive bids until Jan. 24 for furnishing and installing a steam heating system including boiler plant for shops and buildings at 207th St. Yard of Independent system of city subways.

O., Ashtabula—Cleveland Electric Illuminating Co., W. H. Hartman, Purch. Agt., Illuminating Bldg., Cleveland, will soon award contract for superstructure of first unit of power plant here. Estimated total cost including equipment $11,000,000. Private plans.

Pa., Brunots Island—Duquesne-Light Co., 435 6th Ave., Pittsburgh, granted permit for the construction of a steel coal conveyor for James H. Reed power station here. Estimated cost $43,500. Byllesby Engineering & Management Corp., 435 6th Ave., Pittsburgh, is engineer.

Pa., Kittanning — U. S. Engineer's Office, Keenan Bldg., Pittsburgh, will receive bids until Jan. 13, for the construction of a hydro-electric plant at Lock No. 7, on Allegheny River here.

Rhode Island—Narragansett Electric Lighting Co., 76 Westminster St., Providence, plans the construction of two sub-stations one at Arctic, and other at Hope. Estimated cost $125,000 and $90,000 respectively. Private plans.

Tex., Edinburg—Hidalgo Water Contr. & Improvement Dist. 12, is having preliminary plans prepared for the construction of a pumping plant, etc., in connection with irrigation project. Estimated total cost $4,000,000. P. S. Devine. is county engineer.

Tex., Raymondville—Central Power & Light Co., Frost Bldg., San Antonio, will soon award contract for the construction of a 30 ton ice plant here. J. Marriott, Frost Bldg., San Antonio, is engineer.

Tex., San Antonio—San Antonio Public Service Co., W. B. Tuttle, Pres., 201 North St. Mary's St., improvements during 1930 as follows; purchase and installation of new dynamos, electric lines into new districts, equipment, etc. (inside of city limits) $1,500,000; installation high pressure steam turbine and boilers at Station B on Conception Rd. $900,000; high tension lines, two or three sub-stations with equipment, also equipment at Comal plant, New Braunfels (outside city limits) $200,000; gas improvements, new extension gas mains, booster plants, equipment, etc., $500,000.

Tex., Sherman—Presbyterian Board of Christian Education, Witherspoon Blvd., Philadelphia, Pa., is having preliminary plans prepared for the construction of a group of college buildings including heating plant, etc., here. Estimated cost $650,000. Will consolidate Austin, Daniel Baker and Texas Presbyterian colleges into one large institution.

Tex., Sweetwater — City rejected bids on pumping station, filtration plant and pumping equipment at Bitter Creek dam.

Ont., Toronto—Bd. of Education, 155 College St., will receive bids until Jan. 13, for the construction of a school including steam heating, ventilation and ash handling systems, etc. on Mount Pleasant Rd. Estimated cost $1,200,000. C. E. Dyson, 155 College St., is architect.

Que., Montreal—Montreal Island Power Co. Ltd., 421 Power Bldg., plans the construction of a 24 x 38 ft. pumping station.

T. H., Pearl Harbor — Bureau of Yards & Docks, Navy Dept., Washington, D. C., will receive bids until Feb. 26, for alterations and additions to refrigeration plant here.

Equipment Wanted

Electrical Equipment and Pumps—St. Clair Shores, Mich.—City will receive bids until Jan. 31 for electrical equipment and pumps for proposed sewage treatment work.

Engine, Pumps, etc.—Washington, D. C.—A. L. Flint, General Purchasing Officer of the Panama Canal, will receive bids until Jan. 17, for marine engine, pumps, air compressor, electric motors, transformers, etc.

Pump—Goderich, Ont.—Goderich Water & Light Commission, is in the market for a 900 g.p.m. electric pump for power plant.

Pumps, Etc.—Hamilton, Ont.—City plans to purchase pumps, etc., for proposed waterworks filtration plant. Estimated cost $1,000,000.

Industrial Projects

Calif., Long Beach—Lockheed Aircraft Co., 523 West 6th St., Los Angeles, is having plans prepared for the construction of a factory at Long Beach Municipal Airport here.

Ind., Terre Haute — Highland Iron Co., is having plans prepared for the construction of a 1 story, 120 x 400 ft. factory at 28th St. and 4th Ave. Estimated cost $100,000. Private plans.

Ind., Warsaw—Gatke Brake Co., had plans prepared for the construction of a 2 story, 40 x 80 ft. factory. Estimated cost $41,000. Private plans.

Kan., Coffeyville—Ozark Smelting & Refining Co., c/o Sherwin-Williams Co., 601 Canal St., Cleveland, O., will receive bids about Feb. 1, for addition to lithophone plant here. Estimated cost $300,000.

Ky., Louisville—Mengel Co., Dumesnil and 11th Sts., awarded contract for a 2 story, 50 x 400 ft. cigar box factory to Platoff & Bush, 122 West Liberty St. Estimated cost $50,000.

Mass., Cambridge (Boston P. O.)—A. F. Robinson Boiler Works, Second St. East Cambridge, is receiving bids for addition and alterations to factory at Second and Binney Sts. Estimated cost $50,000. D. C. Landry, 107 Massachusetts Ave., Boston, is architect.

Mich., Detroit — Van Leyen, Schilling & Keough, 3440 Cass Ave., Archts. and Engrs., will receive bids late in January for the construction of a 2 story, 75 x 80 ft. tool factory on East Larned St. for Chicago Pneumatic Tool Co., 6 East 47th St., New York, N. Y. Estimated cost to exceed $50,000.

Minn., Sleepy Eye — Midwest Canning Co., New Rochelle, Ill., awarded general contract for the construction of a group of buildings including 65 x 400 ft. warehouse, 88 x 170 ft. factory, 88 x 120 ft. retort building, 30 x 71 ft. power house, etc. to G. Schwartz & Son, Rochester, Minn. Estimated cost $400,000.

N. Y., Brooklyn—Imperial Paper Box Co., Sackman St. and Dumont Ave., plans the construction of a 4 story factory. Estimated cost $50,000. A. J. Fox, 66 Court St., is architect.

O., Berea (br. Cleveland)—Ohio Nut & Bolt Co., 600 Front St., awarded contract for the construction of a 1 story, 44 x 161 ft. addition to factory to Gilchrist Construction Co., Western Reserve Bldg., Cleveland. Estimated cost $40,000.

O., Cleveland — Cleveland Commercial Auto Body Co., J. Schuld, Secy., awarded contract for the construction of a 1 story, 38 x 94 ft. addition to factory at 1717 East 45th St. to J. G. Woide, 1659 East 86th St. Estimated cost $40,000.

O., Cleveland—Sherwin-Williams Co., H. J. Hain, Mgr., 601 Canal Rd., is having preliminary plans prepared for the construction of a 1 story iron oxide plant. Estimated cost $50,000. C. Walton, c/o owner, is architect.

Pa., Tarentum—Tarentum Steel Co., W. Cole, V. Pres., 1716 First National Bank Bldg., Pittsburgh, will receive bids in January for the construction of a steel mill including mills, cranes, docks, railroad sidings, office and equipment here. Estimated cost $3,000,000. L. F. Galbraith, Tarentum, is engineer.

Ont., Brantford—Brantford Oven & Rack Co., will soon receive bids for the construction of a 1 story, 100 x 150 ft. addition to factory on First St. Estimated cost $50,000. J. M. Moore & Co., 489 Richmond St., London, are architects. Equipment for the manufacture of ovens and racks for stoves will be required.

Ont., St. Catharines — Packard Electric Co., Race St., plans the construction of a plant for the manufacture of electric motors. Estimated cost $250,000. Engineer not selected.

Ont., Toronto—Canadian Scale Co., 41 Ossington Ave., awarded contract for the construction of a 2 story, 66 x 102 ft. addition to factory to James W. Hewitt & Sons, 56 Roncesvalles Ave. Estimated cost $75,000.

Ont., Toronto—G. Rathbone Lumber Co. Ltd. Northcote Ave., awarded contract for addition to woodworking plant to James Sim, 79 Lawton Blvd. Estimated cost $125,000.